JUNE 1961

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers

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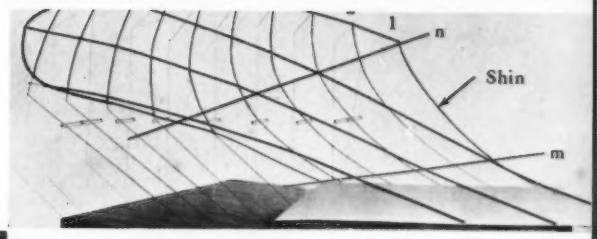

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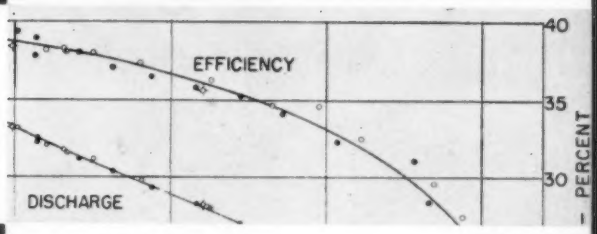

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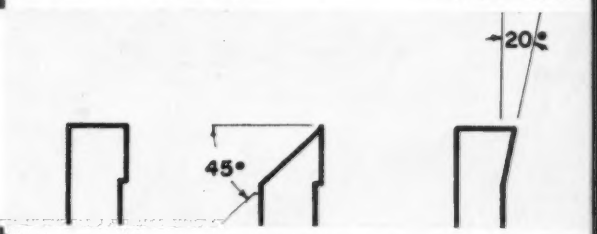

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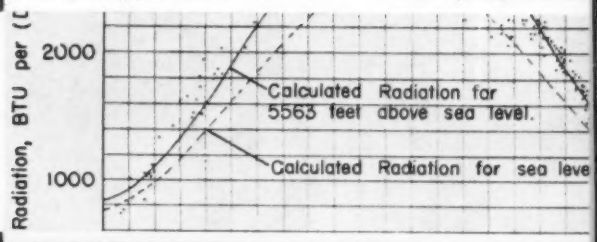

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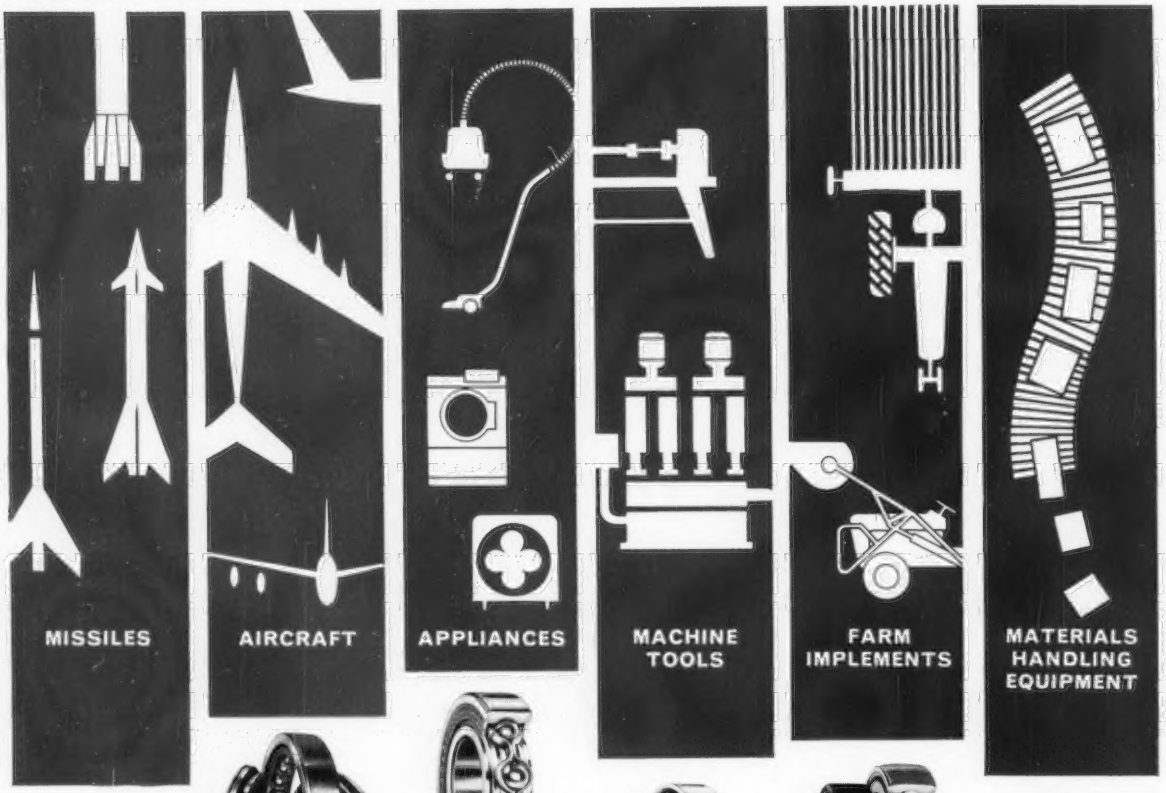

MINIATURE AND INSTRUMENT BALL BEARINGS

Extensive range of ultra-precise ball bearings from ⅛" to 1⅛" O.D. Produced by New Departure to the most exacting requirements found in missile guidance systems and miniature mechanisms of all kinds. Write for catalog—PIB.

AIRCRAFT BEARINGS

Used in today's most advanced engines. Main shaft and accessory drive ball bearings for turbine-driven and reciprocating engines. Designed for ultra-high speeds, heavy loads and high temperature in present and projected air and space vehicles. Write for catalog—ABC.

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A line of quiet-running open, shielded and/or sealed ball bearing types for fractional and integral hp electric motors and machinery of all kinds and makes. Exclusive New Departure integral Sentri-Seals offer Lubricated-For-Life feature. Write for catalog—S.

MACHINE TOOL BEARINGS

A wide range of radial and angular contact ball bearings for spindles and lead screws, made to super-precision tolerances. Also available for gear box and other machine tool applications to precision tolerances. Write for catalog—S.

FARM IMPLEMENT AND EQUIPMENT BEARINGS

Many types and sizes of integrally sealed bearings, specifically designed to reduce application and relubrication maintenance costs in farm implements and equipment of all kinds. Write for catalog—FIC.

MATERIALS HANDLING, EQUIPMENT BEARINGS

Heavy-duty sealed and Lubricated-For-Life ball bearings for belt and trolley conveyors, lift trucks and other types of materials handling equipment. Write for catalog—CB.

32,000 BALL BEARING TYPES, SIZES AND SPECIFICATIONS
...many available with advanced design integral seals

NEW LAND-RIDING SEAL (Crimped)

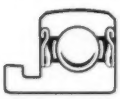
Efficient single-lip seal protects against moist or dry contaminants. Retains bearing lubricant for life. For farm implement discs, idler pulleys, automotive propeller shafts and rear wheels. Available with metal trash guards.

NEW SENTRI-SEAL

N/D's most versatile seal . . . available in most single row, non-loading groove and small double row N/D ball bearings. N/D Sentri-Seals are recommended for general applications where moderate to severe contaminant conditions exist.

NEW TRIPLE-LIP SEAL

Used where moist and dry contaminant conditions are extremely severe. Seal eliminates relubrication maintenance. It's available in N/D square and round bore ball bearings with either spherical or cylindrical O.D.s.



NEW ARMOR-GARD SEAL

Resistant to trash winding and abrasion, Armor-Gard seals are extremely effective under varied field conditions. Here's a highly efficient, low torque, molded synthetic rubber seal which is bonded to and protected by a heavy-duty steel shield.

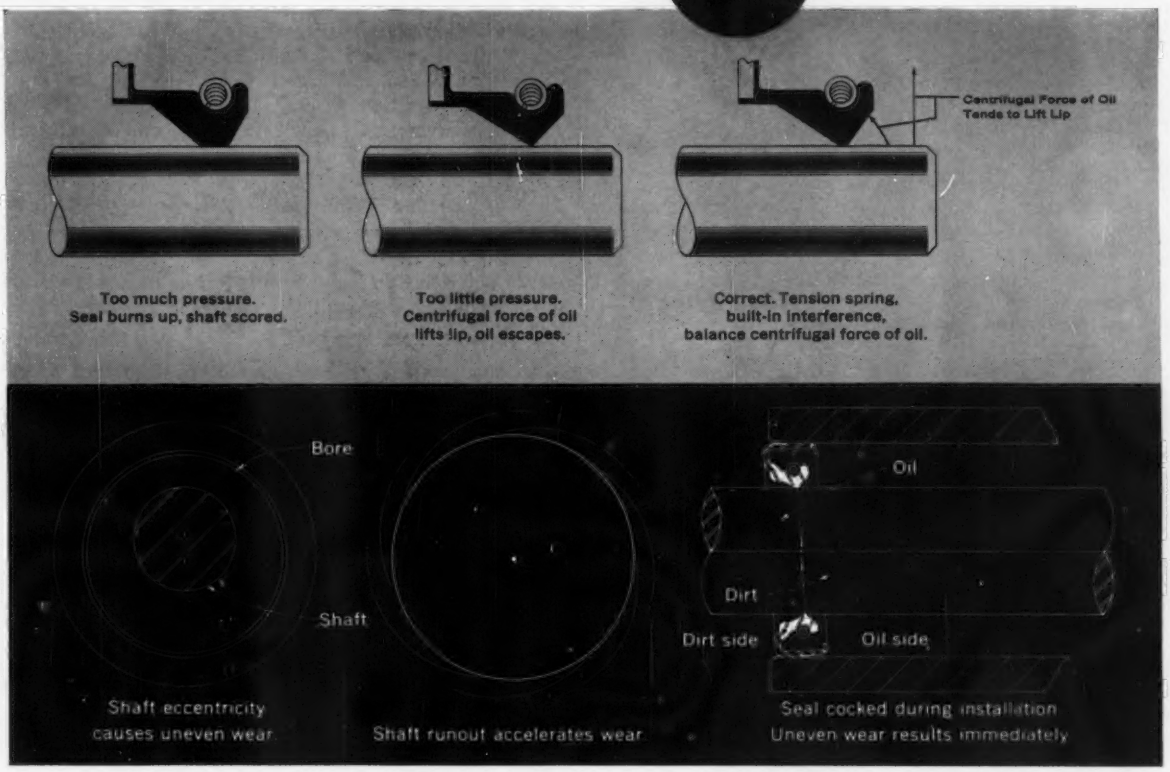
NEW LAND-RIDING SEAL (Pressed) and SENTRI-SEAL

Exclusive heavy-duty conveyor ball bearing and seal combination. Especially resistant to moist contaminant penetration. Land-Riding Seals (pressed) are also available for many farm implement bearings.

Replacement Ball Bearings Available Through United Motors Service And Its Authorized Bearing Distributors

NEW DEPARTURE
DIVISION OF GENERAL MOTORS CORPORATION, BRISTOL, CONNECTICUT

Lip pressure...too much or too little, and you've a leaker for sure!


Centrifugal Force of Oil Tends to Lift Lip
Too much pressure. Seal burns up, shaft scored.
Too little pressure. Centrifugal force of oil lifts lip, oil escapes.
Correct. Tension spring, built-in interference, balance centrifugal force of oil.
Bore
Shaft
Shaft eccentricity causes uneven wear
Shaft runout accelerates wear
Oil
Dirt
Dirt side
Oil side
Seal cocked during installation Uneven wear results immediately

Ideal sealing conditions are (1) shaft in bore center, (2) no runout, (3) seal not cocked, (4) seal concentric, (5) bore round and smooth, (6) shaft round and properly finished, (7) seal proper size.

Meeting these conditions is complicated, frequently requires special seal design or the specialized knowledge of National Seal engineers.

Sealing problems should be anticipated and answered on the board, not in production. Why not call your National Seal engineer now about your current project. He's in the Yellow Pages, under Oil Seals or O-Rings.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
GENERAL OFFICES: Redwood City, California
PLANTS: Van Wert, Ohio; Redwood City and Downey, California

6860

Agricultural Engineering

Established 1920

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CIGR Membership Official

OFFICIAL announcement has been made that ASAE has been granted "National Association" membership in International Commission of Agricultural Engineering (Commission International du Genie Rural "CIGR"), effective May 1, 1961. ASAE membership in CIGR was approved by ASAE members in a letter ballot, which closed on March 27.

Upon approval of its members, ASAE was invited to appoint several committee representatives. K. W. Anderson was appointed association nationale representative to comite directeur. Correspondents also were appointed for each of four technical sections as follows: T. W. Edminster, Section I — Science of Soil and Water; C. F. Kelly, Section II — Agricultural Construction and Equipment Connected with It; L. H. Skromme, Section III — Agricultural Machinery; and C. W. Hall, Section IV — Scientific Organization of Agricultural Work.

Work meetings of the first and second sections have been scheduled for September in Italy. A meeting for both sections will be held on September 4 in Rome and work meetings for Section I in Sardinia, September 5 to 10, and for Section II in southern Italy, September 5 to 10.

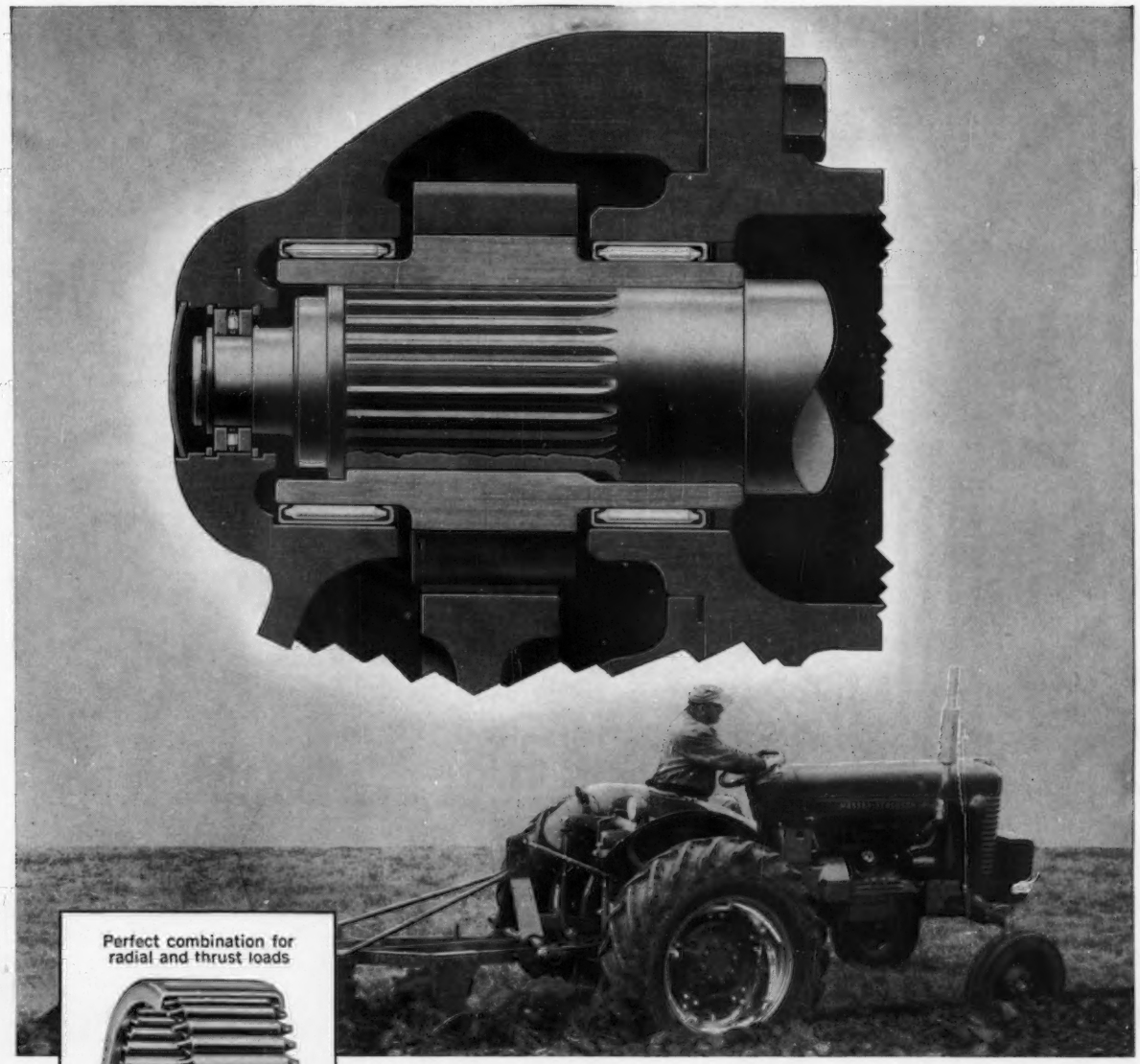
AE Exposition Progress

SHEA Expositions Corp., AE Exposition managers for the ASAE Winter Meeting to be held December 12 to 15 at the Palmer House in Chicago, have referred to the manufacturers requesting exhibit space in the Agricultural Engineering Exposition as "Blue Chips." As of May 15, the exhibitor list totals 22 exhibiting firms. Evidence of the Agricultural Engineering Exposition being viewed with positive enthusiasm is proved by the type of manufacturer requesting exhibit space. U.S. Steel Corp. and Timken Roller Bearing Co. have reserved two exhibit booths each. Crucible Steel Co. will be in Booth 8, and the Portland Cement Assn. has reserved Booth 2. They are joined by such prominent makers of components and equipment as the New Departure Division of General Motors Corp., the Diamond Chain Co., Inc., Minneapolis-Honeywell Regulator Co., Link-Belt Co., and two divisions of Borg-Warner Corp. Reservations for exhibit booths may be made by writing to Shea Expositions Corp., One Gateway Center, Pittsburgh 22, Pa.

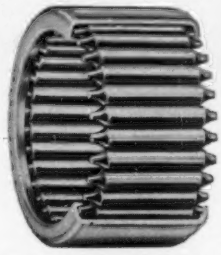
The Peace Corps

ASAE has been contacted by Peace Corps officials expressing a special interest in agricultural engineers for certain assignments. We are pleased to communicate this interest to you.

The Peace Corps came into being on March 1, 1961, when President Kennedy issued an Executive Order establishing the Corps on a temporary basis. While other United States' programs provide military aid, technical assistance, and capital to other nations, the Peace Corps adds a new dimension — the availability of a pool of trained manpower to help other countries meet urgent needs. President Kennedy's order was based upon a comprehensive report prepared by R. S. Shriver, Jr., former president of the Chicago Board of Education. He states that volunteers are wanted in the following major projects: Teaching; fighting malaria and working in other health projects; working in agricultural projects and rural development programs; working on large-scale construction and industrial projects; and working in government administration. For complete information write to Peace Corps, Washington 25, D.C.



Perfect combination for radial and thrust loads



Torrington Needle Bearing

Torrington
Needle Thrust Bearing

For the big pull in tractor performance... Torrington Needle and Needle Thrust Bearings

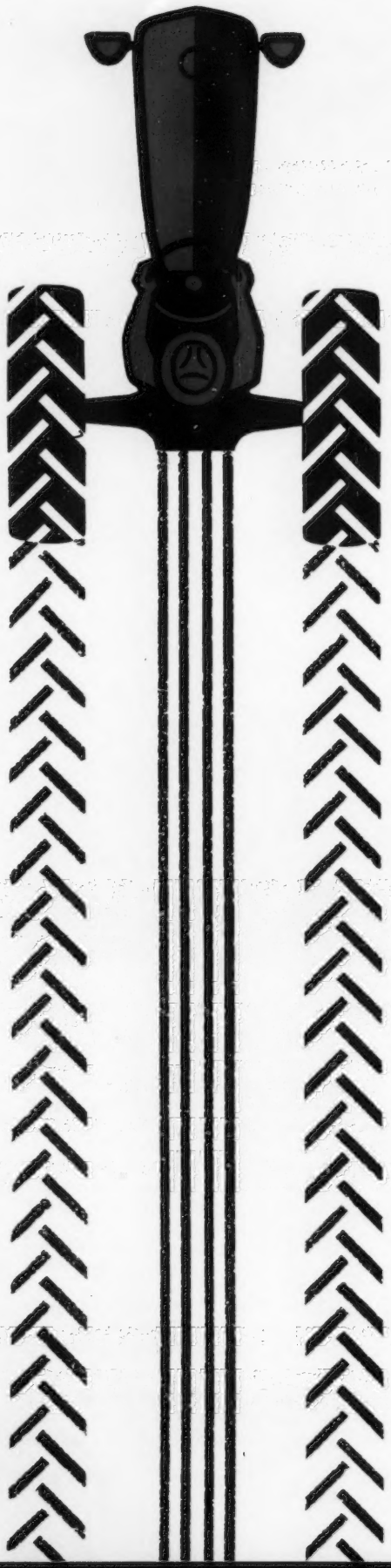
On the world-famous Massey-Ferguson Model 85 Tractor more than 40 Torrington Needle Bearings and Needle Thrust Bearings are used to smooth the transmission of power, operate the power steering, and to provide improved bearing efficiency and operation.

One outstanding application is the drop axle gear set, pictured above. Here, with their full complement of small diameter rollers, two 2¾" shaft size Torrington Needle Bearings provide higher radial load capacity than any other bearings of comparable cross section. To handle the thrust load, a single Torrington Needle Thrust Bearing, with two races, is used to complete the bearing team. The result is smooth, efficient, reliable performance – at greatly reduced cost over bearing arrangements previously used in this type of application.

The combination of Torrington Needle Bearings and Needle Thrust Bearings pays off wherever compactness and high bearing capacity are needed. For advice on *your* application, call on Torrington – maker of every basic type of antifriction bearing.

progress through precision **TORRINGTON BEARINGS**

THE TORRINGTON COMPANY Torrington, Conn. • South Bend 21, Indiana



Tractor buyers get more for their money with New Bendix® Band/Disc brakes

Advantages of both band and disc brake in a single unit

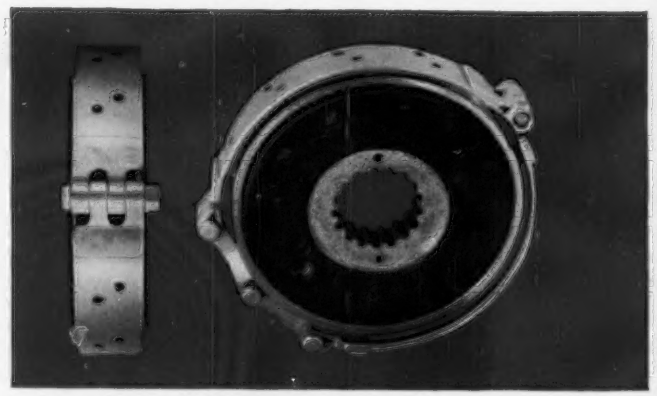
Here is the world's first band/disc tractor brake —created by Bendix, brake headquarters of the world, to combine the advantages of band and disc brakes in a single unit.

More braking power in a smaller package

Bendix design actually increases torque capacity, while reducing brake size, and provides maximum lining area in minimum space. Also steps up efficiency through fast heat dissipation.

Designed for trouble-free operation

Entirely enclosed to seal out dust, mud, and water, and make braking safer. Easier maintenance because there are fewer parts. Adjustments are simple and external.



Bendix band/disc brake can be installed on either wheel or jack shaft.

For further information on this more-for-the-money tractor brake, write . . .

THE Bendix CORPORATION

Bendix PRODUCTS DIVISION South Bend, IND.

"My New Building was Easy... And It'll Grow With My Needs....."

Extension agent Palmer Torvend, left, recommended a West Coast Lumber panelized utility building to berry grower David Saucy, Jr. Saucy bought the panels from his lumber dealer and erected the building, with his neighbors' aid, within a day.

...David Saucy, Jr., Oregon berry producer points out

Dave Saucy saw results in a hurry when his county agent recommended West Coast Lumber's panelized farm building construction...and Saucy's new utility building will always fit his needs...simply by adding new panels.

Extension agents recognize West Coast Lumber's panelized buildings as a quick...easy...economical solution to farmers' building needs. New buildings may be erected in hours...panels may be added to existing panelized structures as needs grow...and panels may be built on the farmstead with farm labor.

Panels are built on a 4-foot module with West Coast Lumber. Trusses for building widths are 24', 30', 36' and 40'. Buildings of any length are possible, and may be left open as in this example, or closed.

Your nearest retail lumber dealer is the source for information on West Coast Lumber's panelized farm buildings. Ask him for the 16-page instruction booklet: "How to Fabricate and Erect Panelized Farm Buildings"... or write:

FREE... Write us today for complete material list, panelization and truss assembly instructions and erection procedure.

WEST COAST LUMBER

WEST COAST DOUGLAS FIR • WEST COAST HEMLOCK
WESTERN RED CEDAR • WHITE FIR • SITKA SPRUCE

WEST COAST LUMBERMEN'S ASSOCIATION

1410 S. W. Morrison, Portland 5, Oregon

Report to Readers . . .

MOLDBOARD PLOW IS RATED BEST TILLAGE IMPLEMENT

Michigan SU soil scientists rate the standard moldboard plow as the best tillage implement that has yet been developed. When it is properly adjusted, they say, the lifting, twisting action of the moldboard crumbles the furrow slice and leaves the soil in an excellent condition for root growth and microbial activity. The moldboard also leaves the soil in an ideal condition for the intake of rain water, and there is a minimum of runoff with the loose soil which holds the water against excessive loss from evaporation. . . . . Measurements of power also show that plowing is the cheapest method of putting soils into the most favorable condition for planting. It is the experience of many farmers that the moldboard plow and a light tillage implement can accomplish all the tillage that is needed to produce maximum yields of corn over a wide variation of soil structure.

DANGER SIGNAL DEVICE HELPS REDUCE TRACTOR ACCIDENTS

A device developed in Britain is designed to cut down tractor accidents. When fitted to a tractor, it sounds a warning and stops the engine when the machine has tilted to a dangerous angle. It is called an anti-rearing and rolling device, and is contained in a sealed metal box that can be fitted between the radiator and grill of any make of tractor in a few minutes. It reacts when a tractor rears or tips sideways or head first too far. . . . . The device consists of a balance weight in a ball joint held in tension by a spring. The tension of the spring governs the angle to which the tractor can tip before the device operates. When the danger angle is reached and the weight counteracts against the spring, electrical contact is made. A solenoid with a 10-pound pull connected to the tractor cutout then takes over, pulls the cutout and stops the engine. At the same time, the signal device sounds a warning which continues until the tractor is again in a safe position.

FIRST GENERAL-PURPOSE GEAR PUMP TO BE MADE OF THERMOPLASTIC MATERIAL

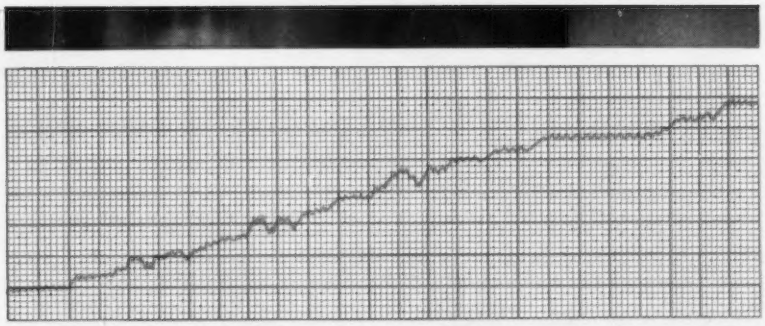
What appears to be the first use of a thermoplastic material for a general-purpose gear pump has recently come to our attention. Tests by an independent laboratory are said to indicate that the plastic reduces horsepower requirements as much as 50 percent below metal models. It is also said that the service life of the pump has been more than doubled, maintenance has been virtually eliminated, and the pump can be mass-produced economically. . . . . All major parts of the pump are made of acetal resin. The solvent resistance and low moisture absorption of this product indicate that these pumps may be used for lubrication, cooling, spraying, and general-purpose handling of farm chemicals.

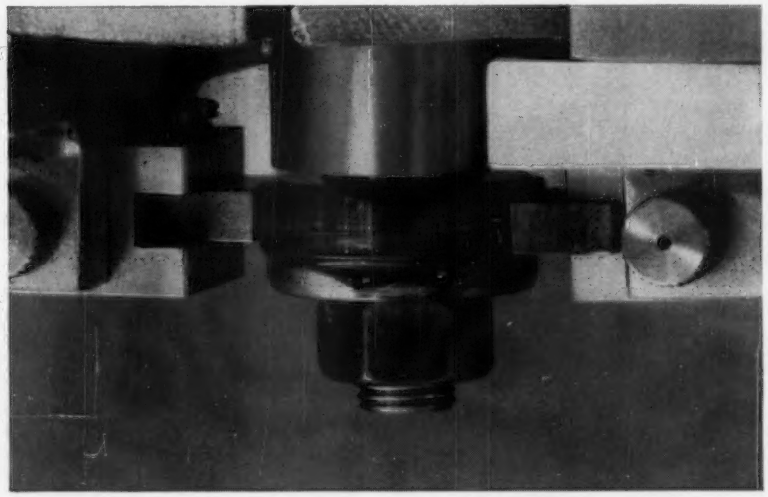
BUNKER SILO COVERS SAVE MORE FEED AND MAKE BETTER SILAGE

Use of a proper seal for bunker silos can result in much less spoilage, seepage, and gaseous loss. This was the general conclusion of a two-year research study by a USDA dairy husbandry-agricultural engineering research team. . . . . It was found that the sealed bunker not only saved more feed, but also produced better silage. Also feed from the sealed bunker was preferred by the dairy cattle to which it was fed, and results showed that they produced more milk and lost less weight than cattle fed from an unsealed bunker. . . . . A polyethylene seal 4 mm thick and costing about 2 cents per square foot was found to be worth the money for sealing the silo, even if used only one season. A more durable material, however, proved to be neoprene-coated nylon that had been tested six years and is still in good condition. . . . . The seals used in the study were anchored to the surface of the silage by covering with 3 inches of sawdust.

(Continued on page 280)

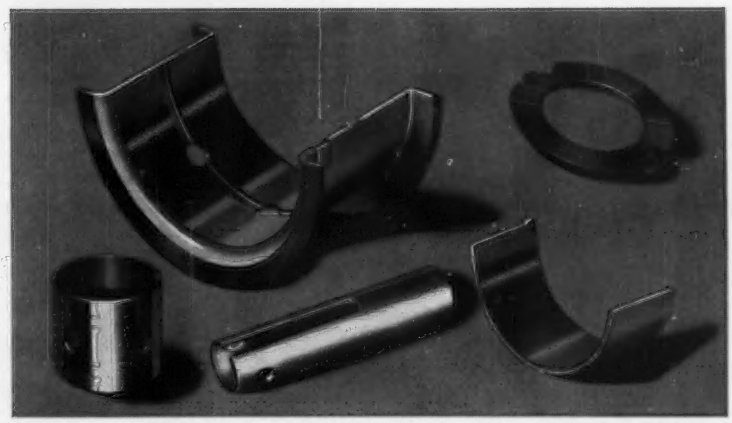
WE TAKE THE PULSE OF BEARINGS ON TAPE TO MAKE THEM EVEN BETTER!





TO TAPE-RECORD THE "HEARTBEAT" OF BEARING METALS UNDER LOAD, WE USE THIS SPECIAL FRICTION AND WEAR TESTER. (left) The result is highly accurate data on the behavior of bearing-metal surfaces, invaluable in our fundamental research into friction. By means of this instrument, we're able to correlate, more closely than ever before, specific alloy compositions with their degree of the "stick-slip" phenomenon (in which one surface sliding over another slides . . . stops . . . slides . . . stops . . . and so on) which accompanies unlubricated sliding action. We can also determine accurately the compatibility of bearing materials with shaft metals in lubricated systems . . . showing us which metal or alloy is most likely to be superior for a given bearing application. In short, this Friction Tester is a fundamental research tool which gives us positive answers to difficult bearing problems, faster than ever before.

ONE REASON WHY F-M SLEEVE BEARINGS and other F-M products give you the finest possible performance — this and the other unusual precision equipment used by Federal-Mogul research. You'll find F-M sleeve bearings used in turbines, engines, and countless other types of power transmission equipment . . . F-M precision thrust washers in pumps, automotive engines and transmissions, motors . . . F-M formed bushings in refrigeration compressors, electric motors . . . and low-cost F-M spacers in motor mounts, machinery, control mechanisms. These are just a few examples.



There's much valuable data in our Design Guides on sleeve bearings, thrust washers, and bushings; and in our brochure on spacers. For your copies, write Federal-Mogul Division, Federal-Mogul-Bower Bearings, Inc., 11081 Shoemaker, Detroit 13, Michigan.

FEDERAL-MOGUL

sleeve bearings
bushings-spacers
thrust washers

DIVISION OF
FEDERAL-MOGUL-BOWER
BEARINGS, INC.

FLAT ROOFS AS SOLAR HEATING UNITS FOR DRYING FARM CROPS

Flat roofs generally make the best solar heating units for utilizing the sun's rays for preheating air for use by hay or grain-drying systems. This is the opinion expressed by a Michigan SU agricultural engineer. . . . . In adapting this solar-heating principle, this engineer has determined the best slopes and directions for facing the roofs under Michigan conditions. While the most efficient solar-drying unit is a movable one that follows the sun, it was found that a flat or nearly flat roof works well enough for farm-drying purposes in Michigan. (A sloped roof facing south was found to do a good job of heating supplemental air, especially for drying corn in winter.) In fact, roofs of existing buildings that face east and west can be used efficiently enough to more than pay the cost of adapting them to solar-heating purposes. . . . . It appears that the only requirement for providing air heated an extra 10 to 15 degrees is a metal roof painted black with a 3-inch heating space under it, together with a duct system for conveying the sun-heated air to the fan of the drying unit.

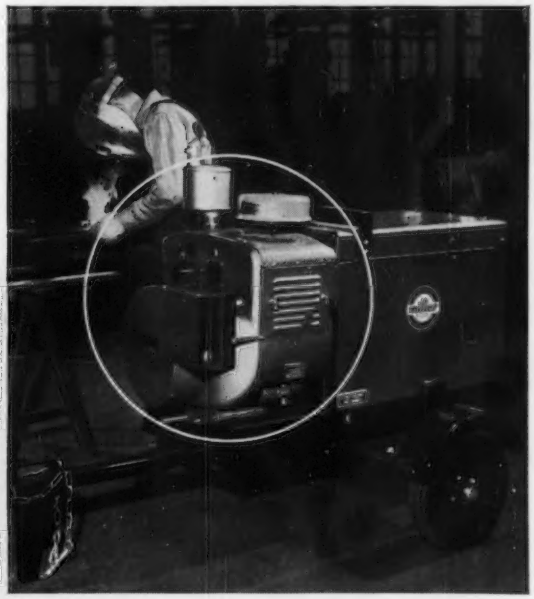
GROWING POTATOES ABOVE GROUND FOR MORE EFFICIENT HARVESTING

The National Institute of Agricultural Engineering in England has for the past two years been testing the feasibility of growing potatoes on the surface of the ground. Should this idea prove to be a success, the engineers believe it would solve an important farming problem, namely, efficient mechanical harvesting of potatoes. With little or no soil to be separated from the potatoes, the crop could be lifted clean and undamaged by mechanical means. . . . . In these trials the NIAE has explored the use of an artificial cover of opaque material such as black polythene film, which is perforated to permit the sprouts to poke through. A number of different types and sizes of perforations in the film was tried out, but a two-inch, cross-shaped cut was found to give best results in facilitating emergence of the sprouts, especially where the potatoes are arranged immediately beneath the cuts. . . . . In the 1959 and 1960 trials, most of the potatoes grown under the film could be gathered by hand; however, in 1960 some of the potatoes were slightly buried in the soil and had to be loosened with a fork. . . . . Good results in growing potatoes by this process for early marketing were obtained simply by lifting up the side of the polythene band and picking the potatoes from the vines as they matured.

ENGINEER CAUTIONS FARMERS ON ELECTRIC FENCE CONTROLLERS

A Michigan SU agricultural safety engineer is warning farmers of the state that the "weed-burner" type of electric fence controller can be a serious fire hazard if used too close to farm buildings. As he warns, "a controller that eliminates weeds can also burn barns." . . . . It is his recommendation that farmers buy only controllers that are approved by the Underwriters' Laboratories or the Industrial Commission of Wisconsin, as the maximum current which the UL and ICW standards allow is not sufficient to start fires or to harm livestock or humans. Other states have outlawed the sale of unapproved fence controllers, but since Michigan has not farmers of the state become prime targets for the sale of weed-burner-type controllers. . . . . The Michigan engineer specifies three basic requirements to assure proper performance of approved controllers: (1) install each fence support at a 45-degree angle rather than vertically, to facilitate mowing weeds near the wire, (2) use only good insulators (without cracks or defects) that deliver maximum current over the full length of the fence, and (3) check the controller's short-circuit indicator every two or three days, but especially in spring when weeds are growing fast. . . . . This engineer's final word of caution to owners of weed-burner type controllers is that they make sure the device and all wires charged by it are in excess of 16 feet from any buildings — better yet that such controllers be discarded before their owners learn the hard way.

Service is important to these Kohler engine users



INDUSTRY

CONSTRUCTION

AGRICULTURE AND GARDENING

These men know Kohler engine service

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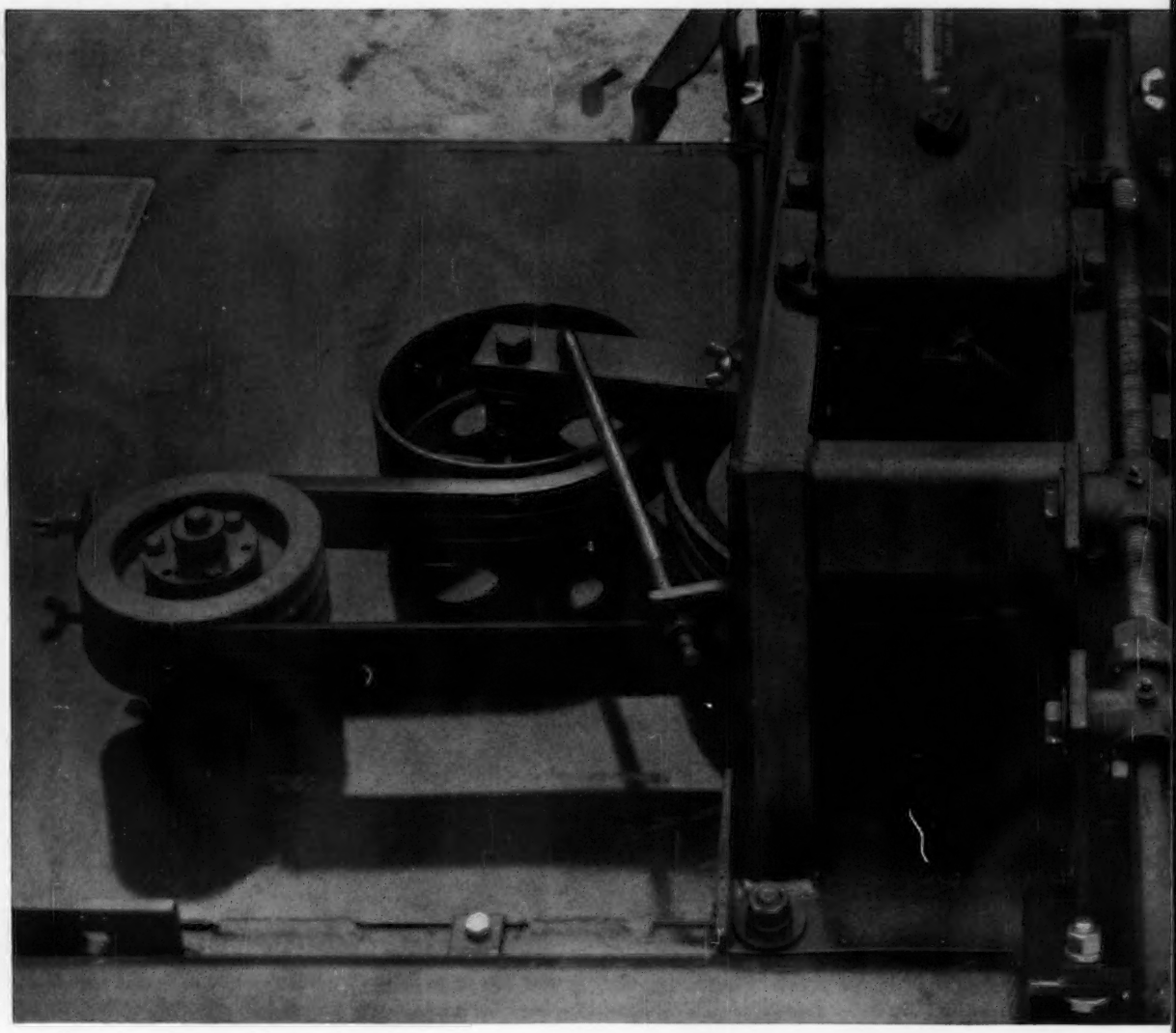


Dayton agricultural V-Belts soak-up "*astonishing*" shock loads

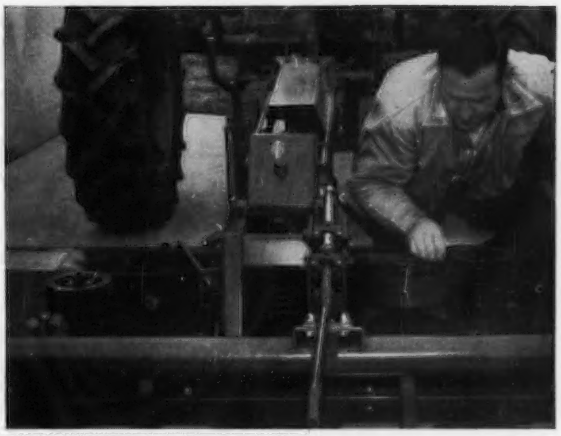
Ever see a rotary mower that could lop the top off a four inch concrete highway marker, or cut an 80 inch swath through a stand of three inch saplings? That's what we mean by "astonishing." This Woods, Model 80 Rotary Mower-Shredder does it with ease. What's more, it can withstand such punishment year after year.

To absorb the tremendous impact involved, Woods uses Dayton V-Belts exclusively. Their superior strength, length stability and resistance to abrasion is perfectly adapted to this rugged duty, which ranges from corn-stalk shredding to highway right-of-way maintenance.

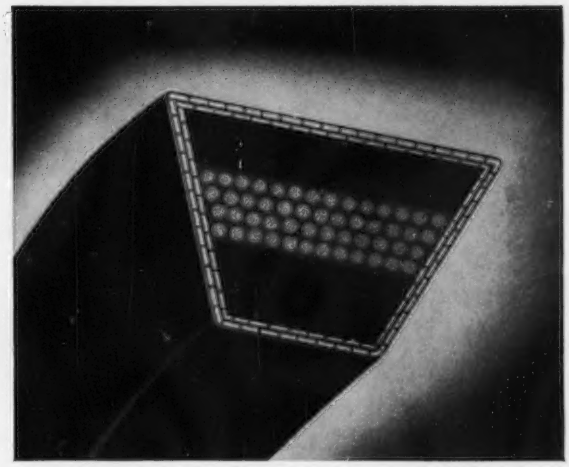
"Dayton's V-Belts," advises Mr. Wood, President, Wood Brothers Manufacturing Co., Oregon, Ill., "absorb shock loads better than a direct drive would . . . [and] protect not only our mower, but several thousand dollars worth of tractor as well."

"We settled on Dayton [B-105 V-Belts] after our own tests, as well as careful observance of field performance, showed that the Dayton product lasted almost *twice as long* as any other belt."

Cleverly designed idler wheels maintain proper belt tension but create torturous reverse bend in belt. The Dayton V-Belts installed are designed to be unaffected by such stresses.



Dayton engineers, working from Wood Brothers specifications, designed a belt of the proper size, tensile strength, composition, etc., to meet their exacting requirements. The resulting belt was just the right answer for Wood's rotary mower . . . a rugged belt that would last a long time.



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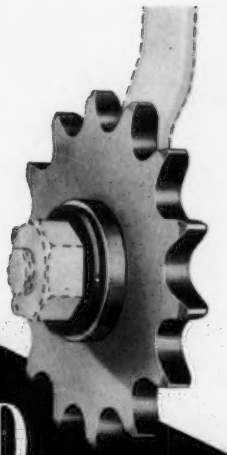

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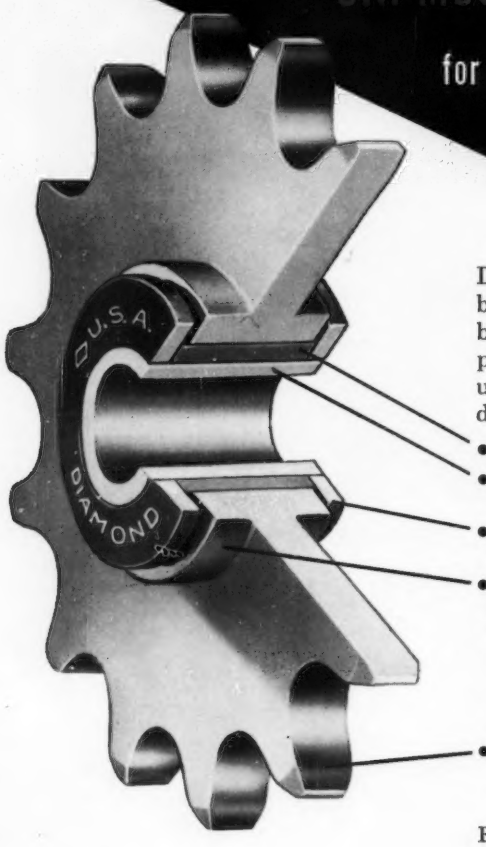
UNI-MOUNT* stock idler sprockets

for your roller chain drive needs



DIAMOND UNI-MOUNT Idler Sprockets are fully assembled, ready for quick, easy installation. They save time because there is no need to procure and assemble separate parts . . . any standard half inch machine bolts can be used. UNI-MOUNT Idlers are low cost, yet extremely durable and reliable for long service life. Here's why . . .

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- Case-hardened steel journal . . . for maximum resistance to wear . . . diameter ground surface for free running under load.
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- Style C steel sprockets used in UNI-MOUNT Idlers are the same as sprockets supplied for high-speed, high-capacity timing and power transmission drives. Because they are stock items . . . machined and heat-treated in large volumes . . . you get a precision built, fully assembled, bearing-equipped UNI-MOUNT Idler Sprocket at a cost only slightly more than the sprocket alone.
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DIAMOND **ROLLER CHAINS**

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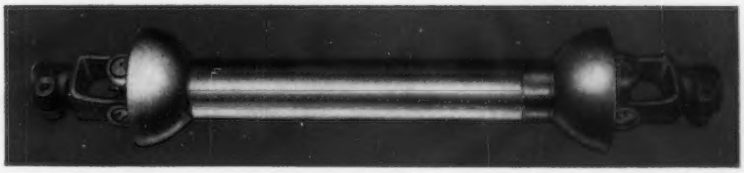
BLOOD BROTHERS JOINTED DRIVE ASSEMBLIES

used on another new farm implement

Greater hay cutting capacity, plus long and dependable performance, makes this New Idea unit an outstanding improvement in mowers. It is the only mower that cuts a ten-foot swath of hay in one pass, with others cutting a seven-foot swath.



The Blood Brothers product used on New Idea's mower is a shielded drive from tractor P.T.O. to gear box. It is typical of the many drive assemblies Blood Brothers furnish for both specialized and conventional farm implements. Manufacturers know that only these highest quality components—products of specialized Rockwell-Standard engineering—can best meet their particular needs.

When you consult Rockwell-Standard engineers, you benefit from a wide range of application experience—involving everything from manual steering assemblies . . . to power take-off drives . . . to heavy-duty propeller shafts. Let Rockwell-Standard save you time and money—to help you achieve higher standards of equipment performance.

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There is a quality called leadership. In business, one way we measure it is by sales.

In 1960, as in every year since the formation of our Company, International Harvester sold more farm equipment than any other organization in the world. In 1960, IH farm equipment sales were almost 17 per cent ahead of the second company, about 20 per cent ahead of the third.

Why?

Why should farmers, the world around, make and keep one company the leader?

There are many reasons. Four perhaps stand out.

The first is that our machines are good. We believe they are the best. They do what they are supposed to do. They keep on doing it for years. And their prices are always competitive.

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A third reason is IH research. From the huge Farm Equipment Research and Engineering Center, near Chicago—the industry's largest and finest—through the many engineering laboratories of subsidiary companies abroad, no other company year-in-and-year-out devotes the manpower, the money, and the facilities to development of new farm equipment that IH does. This is part of a determination to lead; of a deep belief that how good we are is more important than how big we are.

Finally, there is PERMANENCE. Industries change. Particular companies come and go. But our business began 130 years ago when Cyrus Hall McCormick first demonstrated the reaper. It has served farmers of America ever since, and farmers of the world for more than a century. Generation after generation, they have used our products.

When farmers buy International Harvester equipment, they know that however long they keep it, wherever they choose to use it, International Harvester will be here, ready and able to serve them. And their sons. And their sons' sons.

INTERNATIONAL HARVESTER

TEAR OUT AND PUNCH AS INDICATED FOR YOUR FILE

TEAR OUT AND PUNCH AS INDICATED FOR YOUR FILE

BEARING BRIEFINGS

One in a series of technical reports by Bower

ROLLER GUIDANCE— VITAL FACTOR IN BEARING LIFE

Roller guidance has been established by the Anti-Friction Bearing Manufacturers Association as a major rating factor for roller bearings. There is a direct relationship between this factor and the life and capacity of a cylindrical roller bearing under load.

Figure 1 illustrates the results of a loose fit between a roller and the guiding ribs of the raceway. Because of lack of guidance by the ribs, the roller is free to skew and skid under load. Such a condition invariably leads to early bearing failure.

To achieve close roller fit and proper roller guidance, Bower precision grinds each bearing race on specially designed centerless grinders. In this operation, Bower positions the integral raceway ribs *from the theoretical centerline of the bearing*. This method produces bearings with high dimensional accuracy and perfect symmetry.

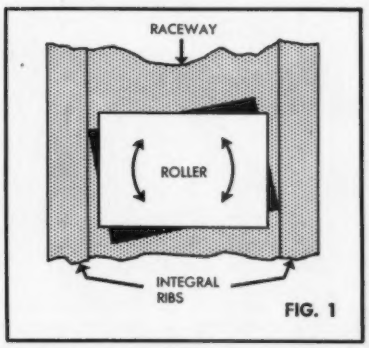
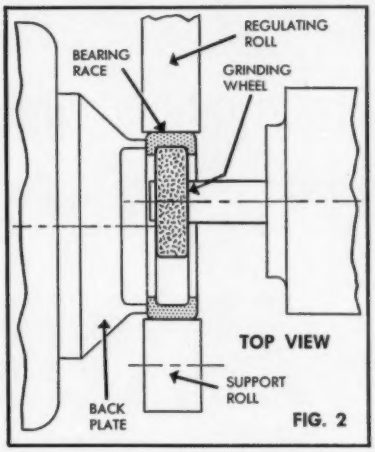
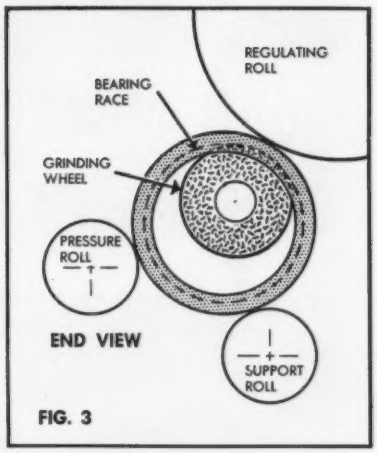


Fig. 1. Loose fit in raceway means poor roller guidance. Roller can skew and skid under load.

In addition, the close tolerances held in grinding the roller track and integral guiding ribs give Bower cylindrical roller bearings the ability to *take thrust in any direction*. A Bower cylindrical roller bearing has thrust capacity of from 10-15% of its rated radial capacity!



Figures 2 and 3 diagram the centerless grinding method used to finish Bower raceways. Use of this technique assures not only optimum roller guidance and maximum bearing life, but also virtually eliminates bearing runout. BEARING SYMMETRY WHICH RESULTS FROM THIS TECHNIQUE PERMITS ACCURATE SHAFT LOCATION REGARDLESS OF HOW THE OUTER RACE AND ROLLER ASSEMBLY ARE INSTALLED. IT COMPLETELY ELIMINATES THE POSSIBILITY OF IMPROPER INSTALLATION.



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Whatever your bearing needs, we suggest you consider the advantages of Bower bearings. Where product design calls for tapered or cylindrical roller bearings or journal roller assemblies, Bower can provide them in a full range of types and sizes. Bower engineers are always available, should you desire assistance or advice on bearing applications.

BOWER ROLLER BEARINGS

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16½-ft. offset harrow gobbles up work with genuine Ingersoll GALESBURG cross-rolled steel discs

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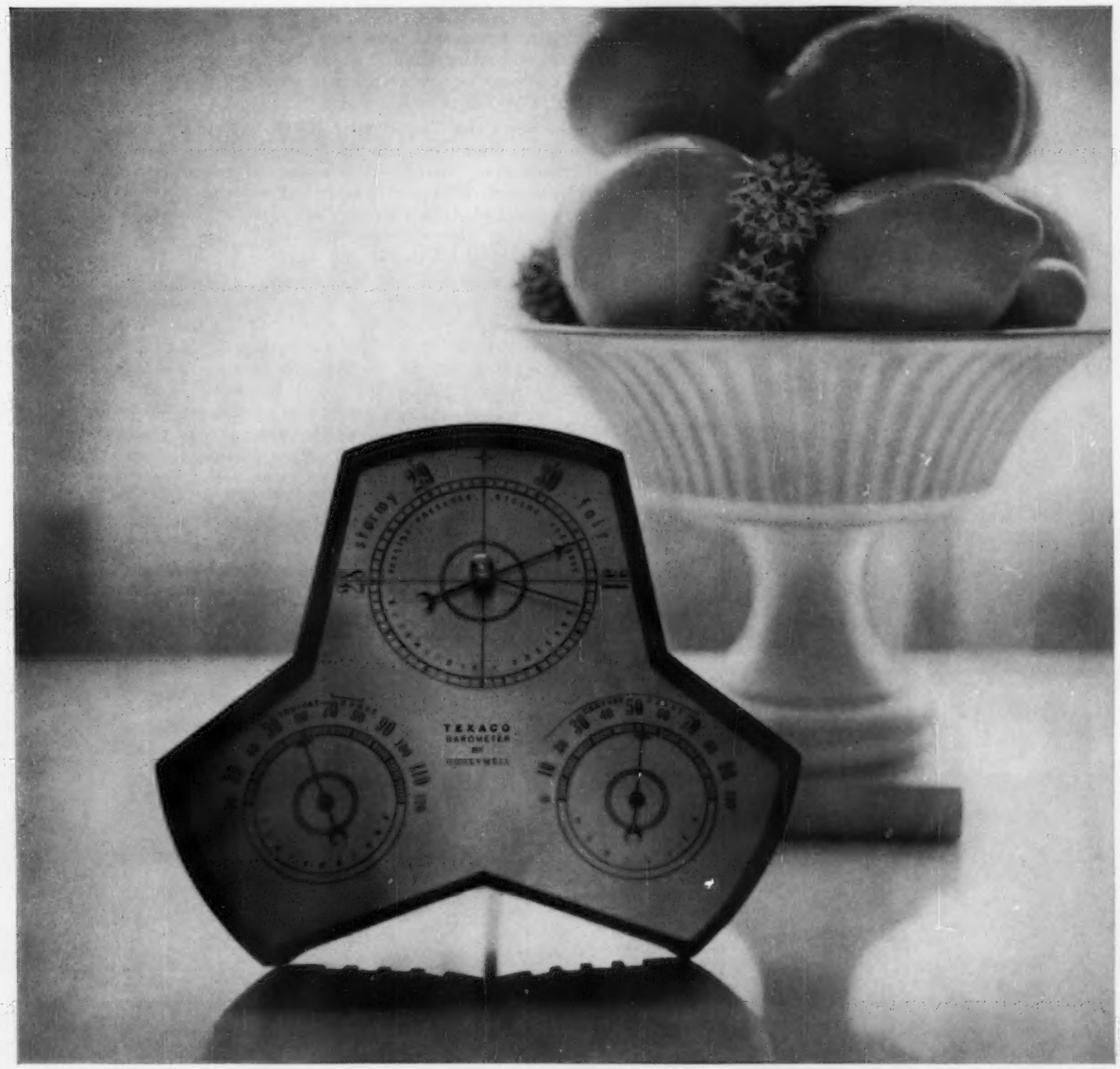

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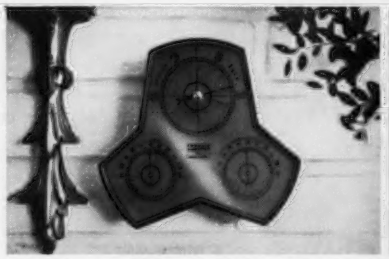

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Hagerstown, Indiana Don Mills, Ontario, Canada

Agricultural Engineering

June 1961
Number 6
Volume 42

James Basselman, *Editor*

Public Relations in Agriculture

Vice-president of Farm Journal, Inc., addresses ASAE Winter Meeting General Session on subject in which all whose livelihood involves agriculture should be vitally interested

Wheeler McMillen

WHEELER MCMILLEN

FIRST of all, I would like to emphasize that agriculture needs to offer no apologies to the American public on any score. Some may think that we need no public relations for agriculture. After all, we are the only business in the country of which everybody *has* to be a customer. That might be regarded as a fairly comfortable and satisfactory situation. As a matter of fact, I believe it is highly important for the non-agricultural population of this great country to understand a few of the basic facts and the real truths about agriculture. After all, we are in position to lead from strength; as I said, we need to make no apologies.

We are a group with many, many publics. We have the supplying public that provides us with the equipment and the goods with which we conduct our production. We have the processing public which picks up our output when it is harvested and prepares it for the public. We have the distribution public which passes it on to the consumer at the point of sale. Very frequently this distributing public is so ill-informed that it blames us for some things of which we are not guilty.

Then there is the tremendous consuming public at the end of the line, the people who are our customers and who wonder what kind of folks we are and what we do. One reason public relations has come into the agricultural picture is because so many Americans are now a generation or two away from the land, so that they no longer have the relationship to it that once was common. There are too many people in the cities who have never heard the grunt of a contented pig; a nice slice of crisp bacon doesn't remind them of anything except bacon.

As engineers you are, of course, devoted to facts. Your performance depends upon your ability to command and interpret facts. I have known the Society for more years than I am going to say. It is a delight, incidentally, to see E. W. Lehmann, Roy Bainer, and a lot of other old friends here in this group today. I have watched you as engineers taking increasingly prominent parts in agriculture and contributing more and more to its progress. But you have had to do it on the basis of facts. I don't suppose there is anyone here who has never made a mistake; if you have, I would guess that the experience resulted either from the absence of facts that were needed or from the misunderstanding of existing facts. Someone once said that there should be no opinions, only facts. Unfortunately we haven't gotten to that point, and in some areas we never shall. But facts are important to all people.

The 180 million Americans who are our customers in these times are involved in our management. They are involved in many, many ways. Their decisions at the polls determine whether we are going to manage agriculture ourselves or whether someone else will govern it. In other words, our 180 million people are the engineers of our republic. They are designing it and redesigning it by the dollars they spend in the market, by the decisions they make at the polls, by conversations they hold with their neighbors.

I doubt whether many of them know that agriculture is the biggest business in America. Many suppose that, because there are somewhat fewer farmers each year, agriculture must be a shrinking industry. After all, agriculture is a 46-billion-dollar business in terms of gross annual income. Those 46 billions of dollars are spent every year for goods that go into the cost of production and for consumer goods, and for taxes; some of it is invested and saved. Twenty-six billion dollars go into production goods and the rest of it into consumer goods or savings. That total of fifteen to twenty billion dollars in consumer goods is a sizable item in our total economy. And if there are any representatives of the consumer goods industries here today, I wish I could advise them to advertise in *Farm Journal* and get the benefit of some of that money.

(Continued on page 308)

An address delivered at the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December 1960.

Plows and Computers

Ernest C. Carlson
Member ASAE

Computers cut time required on "impossible" engineering design problems

HISTORICALLY the Pilgrims tilled their fields in the United States with methods little different than those used in ancient Egypt, Greece and Rome. Drawings as early as 6,000 B.C., in ancient Mesopotamia, show a Y shaped stick that was pulled through the ground by slaves. Except for relatively minor changes, plow design remained dormant for thousands of years, until about 1800 (Appendix 1). The next 160 years produced the greatest progress of all times. Engineering tools, and their usage, had not progressed at a much faster rate. The abacus, the slide rule, the desk calculator and today's computer run a parallel course in history (Appendix 2).

Implement engineering too has been somewhat dilatory in adapting new tools of engineering to assist and accelerate the design programs required in today's farm practices. It is the intent of this paper, first, to present a layman's viewpoint of a computer in order to remove the shroud of mystery surrounding it; and, second, to present an example of the computer's potential in implement engineering.

Plows are a multimillion dollar segment of the farm implement industry. Unfortunately there has always been a lack of theoretical design analysis which can be utilized in plow design; many attempts have been made to provide the necessary mathematical tools, but always the complicated, warped surfaces have halted, and defied progress in this direction. Despite these attempts to lay mathematical foundations, graphical solutions and assumptions are still required and are used as substitutes for the complex mathematics involved.

This does not mean that the empirical design data and practices used to date have been wrong. On the contrary, the plow is quite successful in its performance. The rapid expansion and acceleration of all present-day design programs, coupled with a natural attrition of old-time plow designers, leaves a broad technical gap for the new, young engineer who lacks the required experience in plow design. Then, too, under varying field conditions, operating characteristics may be observed that apparently do not fall into the traditional performance patterns. To analyze these phenomena requires far more than the empirical solutions, however satisfactory, that are historically available.

Now we are well into the era of electronic computers. A great deal of publicity has been given to so-called electronic brains, robots, etc. All of this very glamorous publicity, which applies mainly to missile work or the processing of business data, has misled and blinded implement engineers to the potential advantages offered by computers. Computers can provide a tool for easy handling of the complex mathematics involved in many problems, such as the warped surfaces of plows, thereby freeing the engineer for more creative efforts.

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December 1960, on a program arranged by the Power and Machinery Division.

The author — ERNEST C. CARLSON — is divisional chief engineer, farm implement advanced engineering, Farm Equipment Research and Engineering Center, International Harvester Co., Hinsdale, Ill.

First, let us take a layman's look at computers and the manner in which they function (1)*. In general, there are two categories of electronic computers—analog and digital. There is general appreciation of the difference between slide rule calculations and those performed on a desk calculator. This is a perfect example of the inherent differences between the analog and the digital. Or looking at the face of a watch and disregarding the numbers on the face, the watch is presenting analog information — the angular location of the hands represents time. On the other hand, a numerical clock with counter wheels reading in hours and minutes is a digital display of information.

A digital computer deals in pure numbers, strictly the arithmetic taught in grammar school. It is in effect a highly refined desk calculator. The analog computer, however, deals in quantities, where quantities represent the magnitude of problem variables.

The digital computer is also equipped with a memory to store numbers and can then perform computations in turn similar to a man operating a desk calculator. The old-fashioned player piano is a parallel example where a code punched roll of paper, fed through the piano, will cause a tune to be played.

Finally, in addition to the simple arithmetic functions and a storehouse or memory, the digital computer is capable of making an elementary decision. Specifically, it can choose between two sets of successive instructions depending on whether the answer is positive or negative. This corresponds to a shop inspector checking a piece part with a "go" and "no go" gage.

What makes the digital computer such a powerful tool to use is its fantastically high rate of operation, potentially as great as 60,000 operations per second. Which type of computer to use depends on many things. We are equipped with digitals in our company; therefore, this paper is primarily about digital computers, and is intended to show the potential of this tool in farm implement engineering.

The first thing to realize is that a computer can, and will, do nothing more than the most simple of arithmetical operations, addition and subtraction. Multiplication is accomplished by successive addition; division is accomplished by successive subtraction. While square roots, cube roots, differential and integral calculus, etc., can be performed on the machine, the machine itself does not know a square root or an integral from a treble clef notation. Those complex operations must be reduced to combinations of fundamental arithmetical operations.

With the introduction of computers, it has become necessary to resurrect an old mathematical tool, numerical analysis. This is the branch of mathematics that provides methods for transforming non-arithmetic problems into those consisting of only simple arithmetic steps. For example, it is possible to integrate a function by manually

*Numbers in parentheses refer to the appended references.

adding the areas of infinitesimally narrow strips under the curve representing the function. This is not done, of course, because the method is tedious and time consuming, and for practically all such problems we have a tool called calculus to perform the work for us.

The computer, however, does not know calculus and it cannot be so taught; therefore, it does do the problem the tedious way. It is, in effect, done so rapidly that the operation becomes entirely practical.

In the problem of two equations with two unknowns, a pencil, paper and simple algebra will quickly provide the solution by solving one equation for one unknown in terms of the other unknown and substituting. However, the computer cannot manipulate variables in this manner; it has to work up to the solution by successive approximations.

Fifty equations and fifty unknowns pose an unthinkable problem by the paper and pencil method. However, with the rapidity that the computer can sneak up on the solution by successive approximation, the problem can be solved in perhaps a little more than an hour.

This paper is not intended to teach the reader computer operation, since that is a study in itself. We, as engineers, work closely with computer personnel in solving problems, each supplying the necessary information from his own area of operation. The combination then provides the required solution. In general, there are several steps that must be performed to prepare the problem for the machine.

Briefly, the steps are as follows:

1 FORMULATION: Where the problem is arranged in mathematical language.

2 MATHEMATICAL ANALYSIS: Where the mathematical formula is reduced to a numerical form for machine use.

3 PROGRAMMING: Where the complete logical flow of the problem solution must be established.

4 CODING: Where the detailed sequence of instruction to be followed by the machine is translated into the specialized machine language. The machine must be led through each step and told specifically what to do. Remember, the machine does not think; it only does what it is exactly told to do, no more, no less.

5 CHECKING OUT: Where a test problem with a known answer is sent through the machine to insure correctness of the coding.

6 COMPUTATION: Where the machine runs through the actual problem.

7 EVALUATION: Where the results of the machine are viewed in the light of the physical situation being studied.

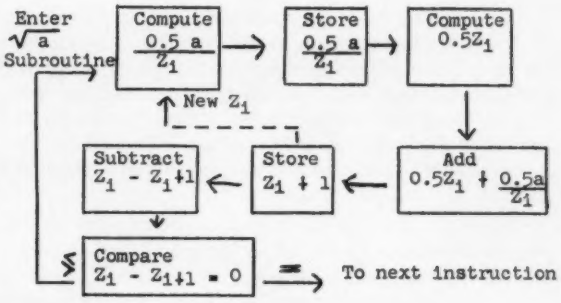
To illustrate simply, take a square root problem. This in itself is too simple for computer work; however, it will serve as an example, both for the general procedure and how any problem must be reduced to arithmetic form for machine operation.

1 FORMULATION: $\sqrt{a}$, where a is any number from 0 to 1. Numbers larger than 1 must be multiplied by a power of 10 before the square root can be found.

2 MATHEMATICAL ANALYSIS: The extraction of square root is taught to grade school students, yet this fantastic "brain" cannot be so taught. The form must be reduced to elementary arithmetic:

$$\sqrt{a}=\tfrac{1}{2}\,(Z_i+a/Z_i)=Z_{i+1}$$

3 PROGRAMMING: In this case, one that commonly occurs in the course of operation and one that is quite repetitive, the programming can become a tedious, time-consuming chore. Therefore, in such common operations, a program simplification is used – the subroutine. This is a prepackaged program that can be fed into the machine and automatically sets up the necessary machine operations.



The operation of comparing $Z_i - Z_{i+1} \begin{matrix} >0 \\ =0 \\ <0 \end{matrix}$ is an example of so-called "logic" capability of the computer.

Steps 4, 5, and 7 will be encompassed in this example by use of the subroutine.

6 COMPUTATION: For the machine to find $\sqrt{2}$, scaling must occur before the number enters the subroutine.

$$\sqrt{2}=\sqrt{0.02\times 10^2}=10\ \sqrt{0.02}$$

The machine begins with a guess of $Z_i=0.5$

$$\sqrt{0.02}=\tfrac{1}{2}\ (0.5+0.02/0.5)=0.252$$

Subtracting 0.252 from 0.5 it finds the answer is not zero—"logic".

It then returns to try again with a new approximation, or guess,

$$Z_{i+1}=0.252$$

The next answers in order are:

$$Z_{i+2}=0.165682$$
$$Z_{i+3}=0.143178$$
$$Z_{i+4}=0.141432$$
$$Z_{i+5}=0.141422$$

It continues, until subtracting the last guess from the next to the last guess gives 0. This occurs when $Z_{i+n}=0.141421$. Here the machine stops, stores the results and either feeds out the answer or goes on to the next instruction in the main point of the program.

It must be emphasized again at this point that the actual time lapse for the machine calculation is far less than the time required to explain this operation.

Since a computer is nothing more than a robot – it cannot think and it certainly cannot create – this function, creativity, is solely the responsibility of the engineer. He must visualize the problem, hypothesize a solution, and predict, to the extent possible, the results of this solution.

. . . Plows and Computers

It is in this area of prediction that the computer serves to its best advantage as a tool of engineering. In accomplishing this phase, basic engineering information will usually be developed.

Of particular interest to note at this time is Thomas Jefferson's letter to Sir John Sinclair in 1798 (2) in which Jefferson explains his theory and development of the principles of plow design, principles that we use today.

Modernizing the grammatical and mathematical structure of Jefferson's letter, we can restate the well-known fact that maintenance of soil pressure per unit area on the moldboard surface is a requirement for uniform scouring and wear. This is to say that ideally the soil is being constantly and uniformly accelerated in an upward and transverse direction as the plow advances, and also that the velocity is constantly increasing.

It has now been shown mathematically (3) that successful moldboards are those having curves, located on planes parallel to the landside which when plotted on semilog paper will have a major portion of those curves represented as a straight line (Figs. 1 and 1a). The upper portions of the curve, while varying considerably, do appear to follow a spiral easement curvature. The spiral easement curve is the theory of uniform pressure curves in the fields of highway and railway engineering.

We believe that this graphical analysis has gone a long way toward furnishing some basic principles for partially checking plow designs, but that it does not provide a handy or complete tool for a mathematical analysis of a plow. If the uniform pressure theory is accepted, as naturally it would be, then a mathematical formula could be developed for the full curvature of the moldboard similar to curves A, B, and C (Fig.2). A plow design would then be quickly and economically accomplished without the limitation of a cut-and-try program.

At this point in our studies, we found out why no such formula had been developed to date. The very concept of such mathematics is difficult to say the least. The calculations required would be comparable to the solving of the fifty equations with fifty unknowns previously mentioned. This, therefore, appeared to be an opportune time to call in the computer experts.

It was then that we received our first introduction to the facts of life — computer life, that is. The first step in making a computer perform for engineers, the mathematical analysis, is probably the most difficult and frustrating stage. In order for the computer to perform its function and derive the curvature formula, if any, of a plow, we would have to furnish the proper information in the way of coordinates

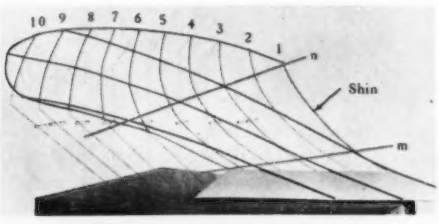


Fig. 1 Curves on planes parallel to landside

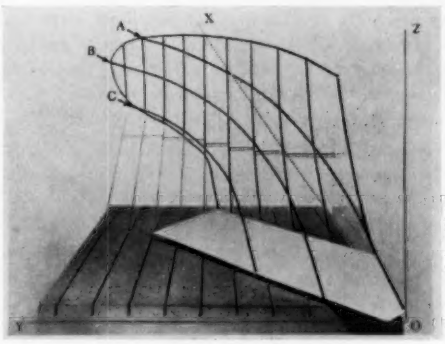


Fig. 2 Flow paths of soil on plastic model

and limits, or parameters. This data was obtained by utilizing known successful, current production plows and plotting the curvature of these moldboards from actual measurements taken at the coordinates X, Y and Z (Fig. 2) (4).

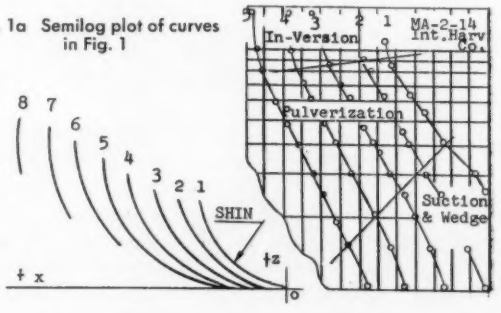
The curves, A, B, and C, in Fig. 2 are the actual flow paths of soil moving over the plow, since we hypothesized that these should be the curves with which to work. The plot of the curves was cross-checked with the analysis proposed by Nichols and Kummer (3) to determine the correlation, if any, and to evaluate our curve relative to known theories. The graphical or drawing board analysis made at this time indicated that a reasonable supposition to be made was that the projected curves were segments of an ellipse.

Had this project been the conventional, empirical approach, we would have proceeded with the design of a plow, fabricated it and determined its value by cut-and-try methods in the field. Fortunately, we did not proceed in this manner since the computer, being capable of providing information of a lengthy and/or complex mathematical nature, unmatched by manual methods, shortly proved the assumption erroneous. Curves, exponential in character, were found to be better suited than elliptical curves. The savings effected by not proceeding at this point were much greater than the time and money expended on the project to date.

The first function of the computer was to take the data of the coordinates, as shown in Figs. 3 and 3a, and provide curves that had the optimum fit to these points. To fit the curve manually would require a tedious set of calculations, and, too, the accuracy could then be subject to question (5).

To simplify the comparison of the actual, or graphical, curves and the computed curves, projections of both sets of curves to the proper planes were used. These curves then took the general form of:

Fig. 1a Semilog plot of curves in Fig. 1



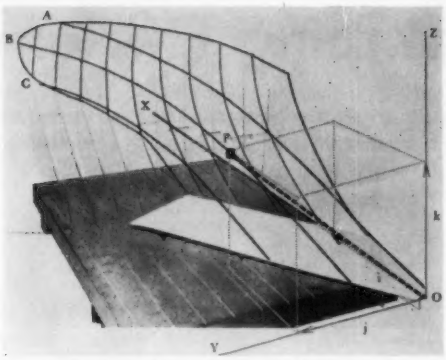


Fig. 3 Coordinates of soil particle "P"

$$y=a_o+a_1x+a_2x^2+a_3x^3$$
$$z=b_o+b_1x+b_2x^2+b_3x^3+b_4x^4+b_5x^5+b_6x^6$$
$$x=x$$

The mathematically derived curves were then compared with the graphic curves to verify the data (Fig. 4). The heavier points in the curve are those obtained graphically, while those indicated by dots were computed.

With the curves in close agreement, the mathematics, and therefore the value of the coordinates x, y, and z, are correct, at least for these curves. If a curve is truly representing a satisfactory scouring path, i.e., uniform soil pressure, then the particle of soil, P, moving over this path will have a constant acceleration and the velocity will be constantly increasing.

Since this is a three dimensional problem in mechanics, it can be greatly simplified by the use of vector analysis (6). Basically, a vector in space is a combination of a magnitude (positive real number) and a direction. With the rectangular coordinate system — O, x, y, z, — chosen originally, then P_1, P_2, P_3, Fig. 3, will be points with respective coordinates.

P_1 : (1,0,0) ; P_2 : (0,1,0) ; P_3 : (0,0,1) (Fig. 3).

The vectors i, j, k, are then defined as follows:

$$i=\overrightarrow{OP_1} \qquad j=\overrightarrow{OP_2} \qquad k=\overrightarrow{OP_3}$$

To analyze the mechanics of the particle P, of mass M, moving in space, the following vectors are utilized:

$$\overrightarrow{OP} \text{ (Position vector)}=r=[f(t)]i+[g(t)]j+[h(t)]k$$

where $f(t)=x$; $g(t)=y$; $h(t)=z$.

DATE 7- 7-60
BOTTOM NO. 1 CURVE NO. 1

PT. NO.	HORIZ. X	HORIZ. DEPTH Y	VERT. Z	PT. NO.	HORIZ. X	HORIZ. DEPTH Y
1	0	.09	0	32	26.00	8.33
2	.906	.09	.656	33	26.70	8.99
3	1.859	.09	.937	34	27.36	9.66
4	2.796	.09	1.218	35	28.03	10.31
5	3.781	.09	1.50	36	28.69	11.03
6	4.75	.09	1.77	37	28.31	11.77
7	5.70	.09	2.05	38	29.95	12.5

Fig. 3a Coordinates determined in the laboratory

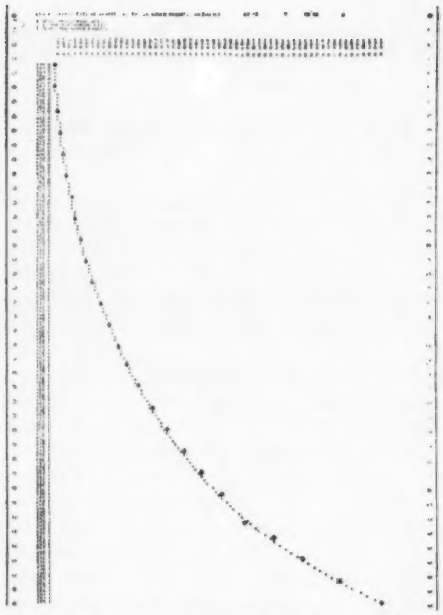


Fig. 4 Plot of curve furnished by the computer

Where $x=t$

$$y=a_o+a_1t+a_2t^2+a_3t^3$$
$$z=b_o+b_1t+b_2t^2+b_3t^3+b_4t^4+b_5t^5+b_6t^6$$

then the first derivative of the position vector is the velocity vector.

$$V \text{ (velocity vector)}=dr/dt=[f'(t)]i+[g'(t)]j+[h'(t)]k.$$

where $f'(t)=1$

$$g'(t)=a_1+2a_2t+3a_3t^2$$
$$h'(t)=b_1+2b_2t+3b_3t^2+4b_4t^3+5b_5t^4+6b_6t^5$$

Then the *magnitude* of the velocity is

$$|V|=\sqrt{[f'(t)]^2+[g'(t)]^2+[h'(t)]^2}$$

The second derivative is the acceleration vector:

$$a \text{ (acceleration vector)}=dv/dt=[f''(t)]i+[g''(t)]j+[h''(t)]k$$

(Continued on page 307)

PLOW ANALYSIS O. JOHNSON
SF STR CURVE NO.1

VARIABL	LENGTH	ACCEL.	VELOCITY	DV/DT	D2V/DT2	DZ/DT	D2Z/DT2
.00	.0000	.0285	1.0631	.085	.000	.351	.028
.50	.5327	.0283	1.0679	.086	.004	.365	.028
1.00	1.0680	.0284	1.0730	.089	.008	.379	.027
1.50	1.6058	.0285	1.0782	.094	.011	.392	.026
2.00	2.1462	.0287	1.0835	.100	.014	.405	.025
2.50	2.6893	.0289	1.0889	.107	.016	.417	.024
3.00	3.2350	.0291	1.0943	.116	.018	.429	.023
3.50	3.7835	.0293	1.0996	.126	.020	.440	.021
4.00	4.3347	.0294	1.1050	.136	.022	.450	.019
4.50	4.8885	.0295	1.1102	.148	.024	.459	.018
5.00	5.4449	.0295	1.1154	.160	.025	.467	.016
5.50	6.0039	.0295	1.1205	.173	.026	.475	.014
6.00	6.5653	.0296	1.1254	.186	.027	.482	.012
6.50	7.1292	.0296	1.1302	.200	.028	.487	.011
7.00	7.6955	.0297	1.1349	.213	.028	.492	.009
7.50	8.2641	.0298	1.1395	.228	.029	.496	.007
8.00	8.8350	.0299	1.1439	.242	.029	.500	.006
8.50	9.4080	.0301	1.1482	.257	.030	.502	.004
9.00	9.9832	.0304	1.1525	.272	.030	.504	.003
9.50	10.5605	.0307	1.1567	.287	.031	.505	.002
10.00	11.1399	.0311	1.1609	.303	.031	.506	.001
10.50	11.7213	.0317	1.1650	.319	.032	.506	.001-
11.00	12.3049	.0323	1.1693	.335	.032	.505	.001-
11.50	12.8906	.0330	1.1736	.351	.033	.504	.002-
12.00	13.4786	.0339	1.1782	.367	.034	.502	.003-
12.50	14.0689	.0349	1.1829	.385	.035	.501	.003-
13.00	14.6616	.0361	1.1880	.402	.036	.500	.004-
13.50	15.2570	.0375	1.1935	.421	.037	.498	.004-
14.00	15.8552	.0392	1.1995	.440	.039	.495	.004-

Fig. 5 Acceleration and velocity data as calculated and printed by the computer

Factors in Drainage Pumping Efficiency

C. L. Larson and D. M. Manbeck
Member ASAE *Assoc. Member ASAE*

Plant design changes that save construction cost without increasing operating cost

IN most of the farm-size drainage pumping plants being built in the Midwest, the pumping plant consists of an enclosed sump, a propeller pump, an electric motor and controls for automatic operation (1)*. Most of the plants operate from March through September discharging tile drainage flow which varies widely with soil moisture conditions.

Construction of an enclosed sump is sometimes a difficult problem because of a high water table, unstable soil conditions, or both. Keeping the sump depth to a minimum helps to reduce these problems as well as saving on materials. Two possible ways of reducing the sump depth are *(a)* reducing bottom clearance or submergence of the pump and *(b)* placing the pump over a pump well within the main sump. The latter arrangement has been used occasionally along with concrete sump floors at the suggestion of U.S. Soil Conservation Service engineers. One major purpose of this study was to determine whether the above methods are feasible on the basis of pumping efficiency.

As reported earlier (1), the volume of storage required for a pumping plant is a function of the frequency of cycling. A limiting value of five cycles per hour was selected arbitrarily, since no experimental data were available. With this value, rather large sumps are sometimes required for storage purposes. Thus, a second objective of this study was to determine the allowable frequency of cycling for a typical propeller pump based on pumping efficiency.

Description of Tests

The tests were conducted with a Fairbanks-Morse, 6-in. propeller pump, Model No. 6340. The pump is rated at 425 gpm at 5-ft total head when driven at 1760 rpm. A 1-hp, vertical hollow shaft, single-phase, capacitor-start, 220-v, 1765-rpm, model ALDP Westinghouse electric motor was used to drive the pump.

The tests were conducted in a 4-ft wide test channel in the experimental engineering building at the University of Minnesota. A 3-ft length of 6-in. horizontal discharge pipe and the manufacturer's basket strainer were used in all the tests. The bottom of the suction bell was 19 in. above the channel floor. A 4-ft wide, 8-ft long and 6-ft high watertight box was added to form the sump for the continuous pumping tests. For the cycling tests, this sump was removed and a waste trough with a 9-ft weir length was installed at the outlet of the channel to maintain a nearly constant water level. In addition, weighing tanks, a wattmeter, electric timers, a gage-height recorder and switches were used in the measurements. A 4 x 4-ft piece of plywood was used as a false floor for the bottom clearance tests and 2-ft (nominal) sections of corrugated steel pipe, 18, 24 and 36 in. in diameter were used as pump wells for the side clearance tests.

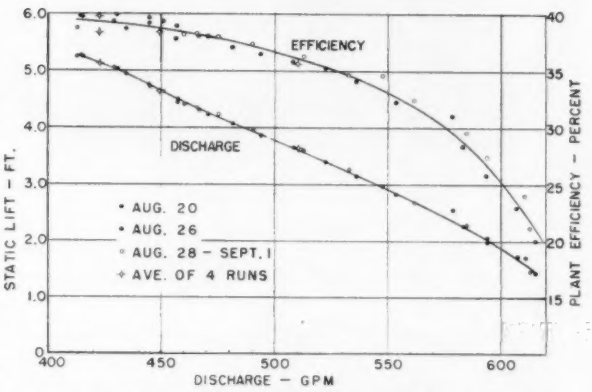


Fig. 1 Performance of the 6-in. propeller pump and motor for continuous operation at 1760 rpm

The procedure for the continuous pumping tests was to adjust the flow of water into the sump to obtain the desired constant static lift. The electric power used and the weight of water pumped were then measured for a period of 2 to 3 min. Measurements were taken to the nearest 0.1 sec, 0.01 watt-hour, 5 lb of water and 0.01 ft of static lift. From these data, the pump discharge, kilowatt and over-all pumping plant efficiency based on the static lift were calculated. This procedure was repeated for various lifts to obtain the rating curve and for the bottom and side clearance tests.

A different procedure was used for the cycling tests. Each cycle consisted of equal amounts of pumping time and standing time, which is the design condition (1). For example, the 6-min cycle had 3 min with the pump on and 3 min off. The inflow of water into the channel sump was adjusted so that, with the pump on, the water level dropped to about 0.04 ft below the weir crest. With the pump standing the water level rose to about 0.07 ft above the weir crest and the water was wasted. For each cycle the average

TABLE 1. EFFECT OF BOTTOM CLEARANCE ON PLANT EFFICIENCY

Date, 1959	Lift, ft	Clearance, in.	Discharge, gpm	Efficiency, percent
8/28	4.63	7	450	38.65
	4.64	19	449	38.40
8/31	3.64	7	510	35.42
	3.64	19	511	35.85
8/31	5.12	7	423	38.60
	5.12	19	423	38.37
9/1	5.12	7	421	39.20
	5.13	19	423	39.81

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The authors — C. L. LARSON and D. M. MANBECK — are, respectively, associate professor of and research assistant in agricultural engineering, University of Minnesota, St. Paul.

*Numbers in parentheses refer to the appended references.

static lift, weighed according to time, was computed. The over-all average was 4.66 ft and all runs were within 0.03 ft of this figure. All of the water discharged by the pump was weighed and the power used during each cycle was measured. Again the over-all pumping plant efficiency was calculated. For each cycle length, several complete cycles were made before measurements were taken. Four runs were made at each of the following cycle lengths: 1, 2, 4, 6, 8 and 12 min.

Results of Continuous Pumping

As a basis for comparison, regular rating tests of the pump and motor were performed, using static lifts from 1.45 to 5.25 ft. These results are presented in Fig. 1. In terms of discharge, good agreement in results was obtained from day to day. However, it was found difficult to obtain repetitive results of the efficiencies on different days, possibly due to the low (200 v) and fluctuating voltage of the power supply. The rating curve agrees well with that of the manufacturer.

The bottom clearances tested had no appreciable effect on the plant efficiency. Four different bottom clearances, 7, 11, 15 and 19 in. were tested. For the 7-in. clearance, the false floor was in contact with the strainer. The average results of four trials of four runs each for the two extreme positions are given in Table 1. Again it was not possible to obtain close agreement of efficiencies on different days for the same static lift and discharge. However, the difference between the means in each pair of efficiencies given in Table 1 is less than 0.5 percent at the 5 percent level of significance. Rather than the usual test for a significant difference, the hypothesis used in each case was that the means are within 0.5 percent of being the same. This proved to be true in all cases. Thus, for practical purposes, the two clearances give the same pumping efficiency.

Three pump-well sizes in addition to the 4 x 8-ft main sump were used to test the effect of side clearance on efficiency. Table 2 contains the average results of four runs each for the two extreme sizes on three different days. For the last trial, the 18-in. pump well was cut down from 26½ to 19 in. in depth to permit a static lift over 5 ft without weir flow into the pump well. Again the difference between the means in each pair of efficiencies is less than 0.5 percent at the 5 percent level of significance. Therefore, the sump sizes tested have no appreciable effect on pumping efficiency.

The minimum test values of bottom and side clearance were slightly less than the manufacturer's recommendations, which were based on tests at 3500 rpm. For a 6-in. propeller pump the latter calls for about 10 in. from the pump center to any wall, whereas a minimum of 9 in. was used in the tests. Likewise a clearance of 2.5 in. below the strainer is specified by the manufacturer and this was reduced to zero in the tests.

TABLE 2. EFFECT OF SIDE CLEARANCE ON PLANT EFFICIENCY

Date, 1959	Lift, ft	Sump size	Discharge, gpm	Efficiency, percent
8/28	4.65	18 in.	449	38.68
	4.64	4 x 8	449	38.40
8/31	3.64	18 in.	509	35.55
	3.64	4 x 8	511	35.60
9/1	5.12	18 in.	421	39.45
	5.13	4 x 8	423	39.81

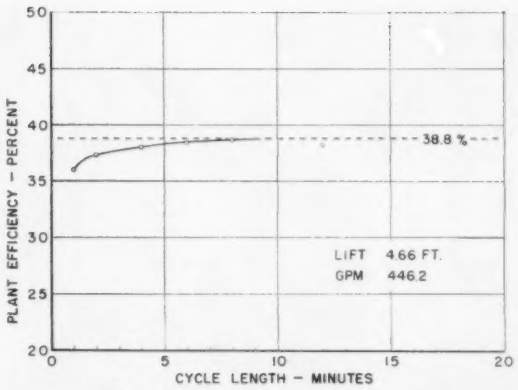

Fig. 2 Effect of cycling on pumping plant efficiency

With regard to submergence, the tests went somewhat beyond the manufacturer's recommendations. As shown in Fig. 1, the maximum static lift was 5.25 ft. This gave a submergence of less than 4 in. as compared to the recommended 15 in., with no noticeable adverse affects. However, at this point the sump water level was actually below the propeller, which could cause bearing failure in case of loss of prime. Because of this, for the pump model used in the tests, the submergence should be at least 9 in., or, in general terms, 1.5 diameters.

Cycling Operation

In the cycling tests, the plant efficiency decreased as the length of the pumping cycle was reduced below 8 min. These results are shown in Fig. 2. At 2 min the efficiency begins to drop off sharply. No reason is evident for the apparent drop in efficiency for the 12-min cycle. The continuous pumping efficiency of 38.8 percent was taken from Fig. 1 at the average static lift (4.66 ft) maintained in this series of tests.

The efficiency values for the various cycle lengths and the reductions in efficiency due to cycling are given in Table 3. A one percent reduction in actual efficiency is indicated for a cycle length of about 3 min. However, this is a loss in relative efficiency of 2.5 percent and a corresponding increase in power consumption.

A second consideration with single-phase motors is the possibility of failure of the starting mechanism due to frequent cycling. Recommendations on this question have been obtained from several leading motor manufacturers (2). The recommendations varied from 8 to 20 cycles per hour, or minimum cycle lengths from 3 to 7½ min.

(Continued on page 305)

TABLE 3. EFFECT OF CYCLING ON PLANT EFFICIENCY

Design-cycle length, min	Plant efficiency, percent	Reduction in efficiency, percent	Increase in power used, percent
1	36.1	2.7	7.0
2	37.4	1.4	3.6
4	38.1	0.7	1.8
6	38.5	0.3	0.8
8	38.6	0.2	0.5
12	38.3	—	—
cont.	38.8	0	0

Measurement of Shearing Energy

Design variables affecting energy required to shear forage materials

J. B. Liljedahl, G. L. Jackson,
Member ASAE *Assoc. Member ASAE*

R. P. DeGraff and M. E. Schroeder
Assoc. Member ASAE *Assoc. Member ASAE*

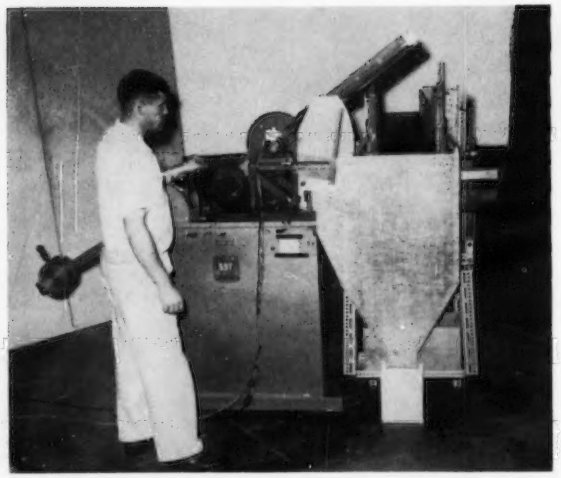

Fig. 1 Apparatus for measuring shear energy of forage materials

THE 1959 U.S. Census reports that approximately 69 million tons of corn and sorghum silage were harvested in the United States in 1959. From studies by Blevins (1)* and others, it can be estimated that approximately 100 million hp-hr of energy were required to cut the yearly production of silage into one-inch lengths. If power from a farm tractor is assumed to cost approximately 5 cents per hp-hr, then the total cost of the power for driving forage choppers in the United States was approximately $5 million not including grass and legume silage.

The problem of trying to evaluate small design changes in an actual forage chopper is complicated because the factors affecting the shear energy are masked by other energy absorbers such as friction and the blower.

The measurement of the shearing energy can be much simplified if the cutting mechanism is completely removed from the forage chopper. The effect of design changes then can be more quickly and accurately measured. Obviously many things affect the shearing energy, but only those that are of concern to the design engineer are discussed in this paper.

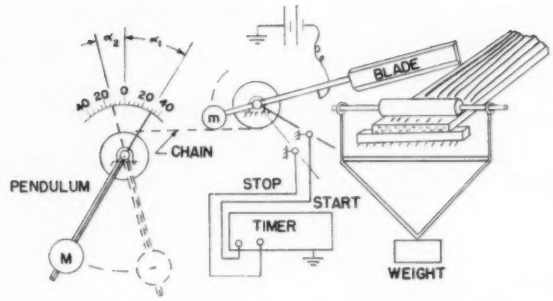

Fig. 2 Schematic diagram of shear energy measurement apparatus

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December 1960, on a program arranged by the Power and Machinery Division. Approved for publication as Journal Paper No. 1735 of the Purdue Agricultural Experiment Station, Project 922.

The authors — J. B. LILJEDAHL, G. L. JACKSON, R. P. DEGRAFF and M. E. SCHROEDER — are, respectively, professor and former graduate research assistants, agricultural engineering department, Purdue University, Lafayette, Ind.

*Numbers in parentheses refer to the appended references.

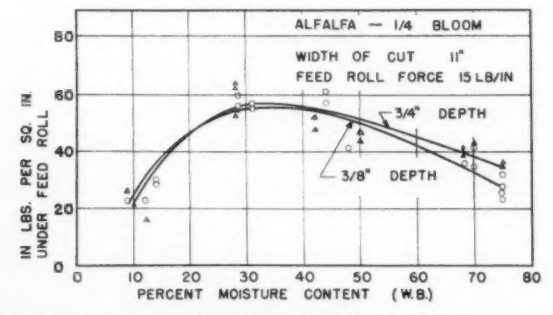
ALFALFA — 1/4 BLOOM
WIDTH OF CUT 11"
FEED ROLL FORCE 15 LB/IN
3/4" DEPTH
3/8" DEPTH
IN LBS. PER SQ. IN. UNDER FEED ROLL
PERCENT MOISTURE CONTENT (W.B.)

Fig. 3 Energy required to shear alfalfa based on cross-sectional area under feed roll

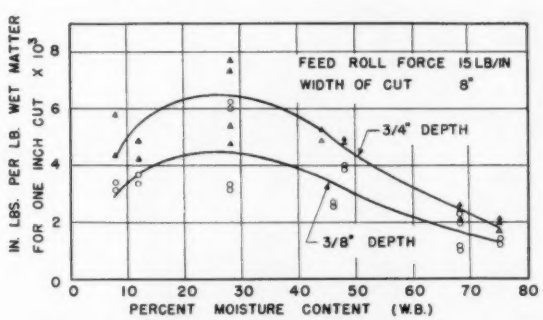
FEED ROLL FORCE 15 LB/IN
WIDTH OF CUT 8"
3/4" DEPTH
3/8" DEPTH
IN. LBS. PER LB. WET MATTER FOR ONE INCH CUT X 10³
PERCENT MOISTURE CONTENT (W.B.)

Fig. 4 Energy required to shear alfalfa hay

Within recent years some effort has been given to the search for basic knowledge related to the physical properties of agricultural projects. Some workers, notably Fischer-Schlemn (2), Chancellor (3), Richey (4), Prince (5), McClelland (6) and Feller (7), have directed their efforts toward the study of shearing mechanisms used on agricultural machines.

Procedure

Some of the plant variables which affect energy are *(a)* moisture content, *(b)* maturity of the crop, and *(c)* the variety of crop.

Of more concern to the engineer are design variables, some of which are *(a)* clearance between the blade and the shear bar, *(b)* the dullness of the cutting knife, *(c)* the shear bar configuration, *(d)* thickness of the cut, *(e)* width of cut, and *(f)* feed roll force. In addition to the design variables just mentioned, there are several more which were not studied in the investigation reported in this paper. They are *(a)* knife velocity which could not be varied and was held constant at about 480 fpm; *(b)* the relief angle behind the knife was held constant at 3.2 deg, *(c)* the knife-edge angle was held constant at 30 deg, and *(d)* the shearing angle between the knife and the shear bar was not varied.

A Baldwin-Lima-Hamilton Model FPL wood impact testing machine (8) was available and was used as a basis for the apparatus. The completed apparatus with the B-L-H testing machine is shown in Fig. 1. The operation is made more apparent when observing the schematic diagram shown in Fig. 2. To operate the apparatus, the pendulum is tripped which pulls the chain, which in turn rotates the blade cutting off a predetermined length of forage.

From the conservation of energy equation it can be shown that the cutting energy E_c must be equal to the input energy E_i of the pendulum minus the kinetic energy E_{ke} of the blade assembly minus the energy to overcome friction E_f.

$$E_c = E_i - E_{ke} - E_f$$

E_i can be calculated or, as in this case, determined from a table furnished with the Wood impact testing machine. E_{ke} was calculated from the equation $\frac{1}{2} I_o \omega^2$, where I_o was the mass moment of inertia of the blade assembly about its center of rotation. I_o was determined by considering the knife assembly as a compound pendulum. In the frequency equation $f = (1/2\pi)(mgL/I)^{\frac{1}{2}}$ (2), everything can be measured, except I, which can then be calculated.

The angular velocity of the knife assembly, ω, in radians per second was determined by using an electronic counter.

E_f, the energy lost due to friction in the system, was determined by a no-load calibration with E_c equal to zero.

In order to minimize the possible errors in the system, the design variables studied were randomized and three or four replications of all tests were performed.

Hay was kept at 35 F in sealed plastic bags in a refrigerator when it was not being used in the experiment. All of the tests for a particular season were conducted with the same hay from a single batch kept at a constant moisture content. Hay used in the tests was thoroughly mixed and placed in the shear energy apparatus in such a fashion that the individual stalks of hay were randomly arranged.

Results

The use of the B-L-H wood-testing machine made an excellent basis for the construction of a shear energy apparatus. This method probably allowed an error no larger than ±5 percent in the determination of the final shear energy. By the use of a large sample, approximately equal in size to that which would be cut in a conventional forage chopper, the effect of individual variation and arrangement of forage stalks was insignificant. Over 1,220 separate determinations were made in obtaining the information presented.

The first method of plotting the results of the tests is shown in Fig. 3 (10). This is a plot of energy in inch-pounds per square inch of forage under the feed roll against the moisture content of the hay for two different depths of material. It appears at first glance that depth of cut has no effect.

Fig. 4 is the same data as shown in Fig. 3, except that it is plotted in inch-pounds per pound of wet material per one-inch length of cut as a function of percent moisture of the hay. It can be seen that, as the moisture content of the hay becomes extremely wet or extremely dry, the energy consumed in the cutting process decreases. It also appears that the energy consumption increased as the depth of cut increased.

Approximately 25 percent more energy was required to cut the material when ¾ in. deep as compared to ⅜ in. deep.

Two widths of cut, 8 and 11 in., were studied and found to have no effect upon the shear energy.

Fig. 5 shows the profiles (magnified 33 times) of three of the four blades that were used on the testing device. The three blades were purposely dulled with an oilstone and the radii then determined by taking lead impressions which were then placed in an optical comparator to determine the actual shapes and radii of the cutting edges. The fourth blade used had a sharp edge of approximately zero radius.

The effect of dulling is shown in Figs. 6 and 7. The energy required for shearing is plotted as a function of moisture content. The energy increased substantially as the radius of the dulled edge increased. In Fig. 6 the range of the moisture content was not as large as it was in Fig. 4; consequently the section of the curve shown was approximately a straight line.

In Figs. 3, 4, and 6 the energy is in inch-pounds per pound of wet material per inch of length. The moisture content is wet basis.

In Figs. 7, 9, and 10 the energy is in inch-pounds per pound of dry matter. Fig. 7 indicates the effect of clearance between knife and shear bar, depth of cut, and dullness of the knife blade upon the energy to cut one pound of dry matter. It is apparent that, for a very sharp blade with no dulled radius, clearance has no effect. The effect of clearance becomes more pronounced as the dullness increases. In all cases the effect of depth of cut seems to be approximately the same. Approximately a 25 percent increase in

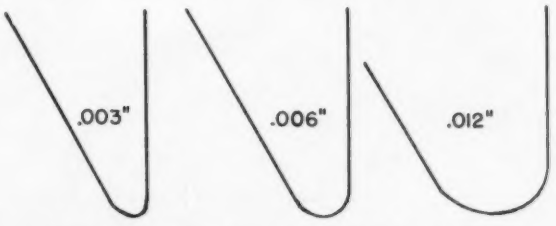

Fig. 5 Energy profile tracings from three dulled blades

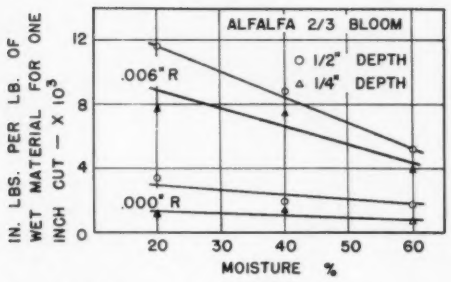

Fig. 6 Effect of moisture content and sharpness on energy per pound of wet material

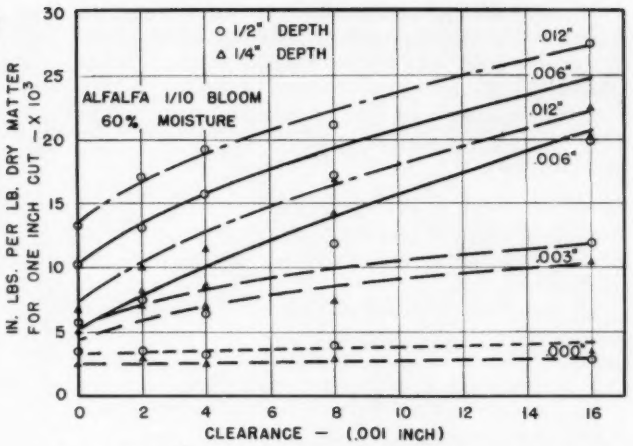

Fig. 7 Effect of clearance, depth, and blade sharpness on cutting energy for shear bar A

the shearing energy was required as the depth of cut increased from ¼ to ½ in. It appears that control of the sharpness is more important than control of the clearance since a very sharp blade is relatively unaffected by the clearance. For the extreme condition of 0.016 in. clearance and 0.012 in. radius at ½ in. depth of cut, the energy required for cutting increased six to seven times compared to a sharp blade.

A study was made of the effect of shear bar configurations, the profiles of which are shown in Fig. 8. It was realized that the sharpened shear bar would very likely be a difficult type of shear bar to use in actual practice, but nevertheless knowledge regarding its effect on shearing energy was desired. A third type of shear bar studied had a relieved cutting edge similar to a lathe cutting tool. Difficulties occurred immediately in trying to use such a relieved shear bar. One was the problem of attempting to control or to measure the actual clearance between it and the cutting knife. A second difficulty was that the forage material wrapped over the edge of the shear bar for the conditions of large clearance.

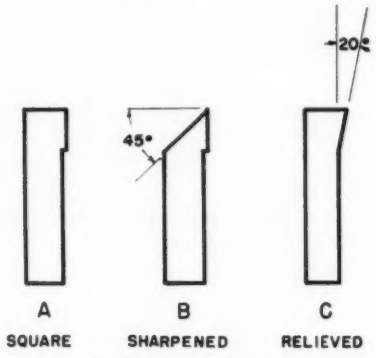

Fig. 8 Shear bar profiles

The results of the relieved and square shear bar tests were approximately the same and therefore were shown in Fig. 9 as one curve. Fig. 9 compares the energy required to shear forage material for the various shear bars as a function of the blade edge radius in thousandths of an inch. It appears that, as the blade edge radius increases (that is, the blade becomes duller), the effect is much more pronounced on the square shear bar, and when the blade edge radius is zero that the shear energy for the two shear bars is approximately the same.

There may be too many problems associated with the use of a sharpened shear bar to make its use practical. But, if these difficulties could be overcome the use of a sharpened shear bar would significantly reduce the shearing energy when used with dull blades.

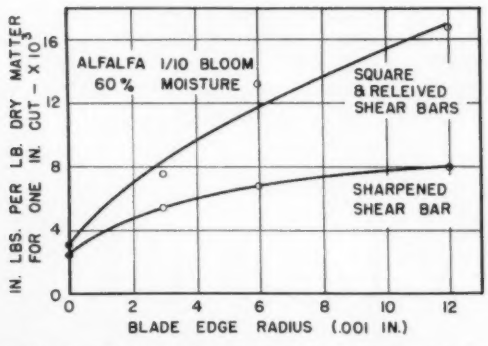
ALFALFA 1/10 BLOOM
60% MOISTURE
SQUARE & RELEIVED SHEAR BARS
SHARPENED SHEAR BAR
IN. LBS. PER LB. DRY MATTER FOR ONE IN. CUT — X 10³
BLADE EDGE RADIUS (.001 IN.)

Fig. 9 Effect of blade sharpness on cutting energy with zero clearance

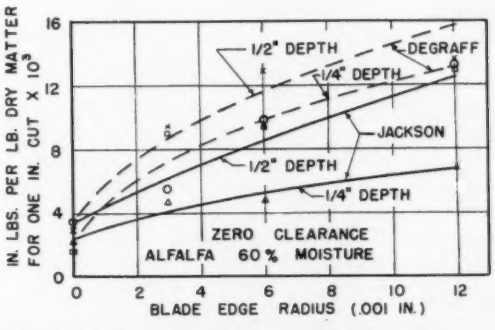

Fig. 10 Effect of blade sharpness and thickness of cut on cutting energy

Fig. 10 makes clear the effect of the clearance between the knife and the shear bar. The curves by Jackson (11) and DeGraff (12) are from data using the same equipment and similar material; however, in the case of the data by Jackson the end of the knife was guided by two cam followers so that the clearance between the knife and the shear bar was more accurately controlled. Data by DeGraff were collected using the same apparatus, except that the end of the cutting knife was not guided. As the blade-edge radius increased, there was apparently a deflection of the end of the knife which affected the total energy requirement.

Following is an example of how this information can be used to predict the power consumption of a forage chopper: Assume alfalfa at 60 percent moisture is being chopped into 1-in. lengths in a layer ½ in. deep at the rate of 1,000 lb per minute. The knife clearance is 0.008 in. and the knife is dulled to a radius of 0.006 in. From Fig. 8 the energy required is found to be 19,000 in.-lb per pound of dry matter per inch of length. The required cutting horsepower will be

$$\text{hp} = 19{,}000/12\ (\text{ft-lb/lb}) \times 1{,}000\ (\text{lb/min}) \times 40/100\ (\text{ratio dry to wet matter}) \times 1/33{,}000\ (\text{min. hp/ft-lb}) = 19.2\ \text{hp}$$

If the same forage chopper is adjusted to zero clearance and the blades are sharpened, the shear energy becomes 3,500 in.-lb per pound and the required horsepower for cutting is now 3.5. The saving is 15.7 hp. If it is assumed that 40 percent of the power required to run the forage harvester is absorbed by the cutting mechanism, which is a reasonable assumption according to Blevins, the total required power is 48 hp. The reduction in the total required horsepower when cutter is readjusted is equal to 15.7× 100/48, or approximately 33 percent.

Conclusions

1 Shear energy values appear to be the easiest to apply to actual field machines if they are reported as energy per unit of weight for a specific length of cut.

2 The width of cut had no affect on shear energy.

3 Depth of cut was significant. Increasing the depth from ¼ to ½ in. increased the energy by approximately 25 percent when cutting alfalfa.

4 Moisture content had very little effect on shear energy for the condition of a sharp blade. As the blades become dull, the effect of the moisture was more pronounced.

5 The clearance between the knife and the shear bar had very little effect on a sharp blade, but had a significant effect on dull blades.

6 A relieved shear bar was no better than a square shear bar.

7 A sharpened shear bar, as compared to a square shear bar, decreased the shearing energy by approximately 50 percent when the blade edge was dulled to a radius of 0.12 in.

8 Clearance must be very accurately controlled in shear test apparatus if the values are to be meaningful.

9 The effect of knife clearance and knife sharpness was very pronounced. It appears that a means of including a sharpening device on a forage chopper should be considered when it is designed.

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New Irrigation Research Report Available

A METHOD for setting up channels of communication between research workers is to have available a reference that contains a listing of irrigation projects being carried out by research groups in the various states and provinces. Communication can result in better designed research studies, improved instrumentation, higher quality data and reduced duplication of effort.

The ASAE Committee on Sprinkler Irrigation Research for 1960, consisting of J. F. Thornton (chairman), Gilbert Levine, Crawford Reid, F. W. Peikert, W. J. Liddell, J. F. Wiersma, C. H. Pair, W. F. Lytle, and T. V. Wilson, has compiled a report on irrigation research in the United States and Canada. In this 115-page report, the committee has compiled the following information on listed research projects: Project title; cooperating departments and agencies; project leaders; location; brief description; objectives; major results to date; publications; and remarks (proposed revisions, etc.). A similar report was compiled in 1955.

The 1960 report is available from the American Society of Agricultural Engineers, 420 Main St., St. Joseph, Mich. The price to members is $1.00, postpaid, and to nonmembers $1.50, postpaid.

Fellowship Sources List

A SELECTED list of major fellowship opportunities and aids to advanced education is available from the American Society of Agricultural Engineers, 420 Main St., St. Joseph, Mich. The six-page list includes loan sources for undergraduate fellowships, graduate fellowships, and postdoctoral fellowships, as well as publications listing scholarships and fellowships.

Availability of Solar Energy

C. F. Becker and J. S. Boyd
Member ASAE *Member ASAE*

Method for estimating the quantity of solar energy available on surfaces with various orientations in the United States

RADIATION from the sun is essentially the primary source of all energy used by mankind. Energy supplies that are most easily utilized, such as the fossil fuels, have undergone natural concentration. During the past decade the scientific interest in the use of solar energy directly has increased.

Solar energy is a potential source of power that offers much promise in the near future. Already it is being used for distilling sea water, drying fruits, obtaining high temperatures, and heating water. Solar house heating, now in the experimental stage, shows much promise. Work is also being done in the fields of photoelectricity, photochemistry, and photosynthesis, where an attempt is being made to shorten the time necessary for completion of the process by which petroleum was naturally formed. Very little research has been done to determine the possibilities of using solar energy on the farm, even though it appears to be a logical place to begin, since large enough areas are available for collectors and storing units, and the temperatures required for drying products and ventilation are lower than in other applications.

Intensity of Solar Radiation

To utilize solar energy at the surface of the earth for engineering application it is necessary to know the availability of the supply. The solar constant (4)*, the energy upon a unit surface located at mean distance of the earth from the sun and oriented perpendicular to the sun's rays beyond the atmosphere, is 440 Btu per (day)(sq ft). The spectral distribution of the energy outside the atmosphere lies between the limits of 0.22 and 7 microns.

In tracing this solar spectrum down through the atmosphere, during cloudless days, depletion of the direct beam takes place by scattering and absorption due to the air molecules, dust, water vapor and ozone (3). The average amount of the substances mentioned are known and consequently the amount of depletion has been estimated for the various lengths of paths or air mass the sun's rays must pass through (5). The angle at which the sun's rays reach a surface on the earth for a given hour and day can be determined and the energy incident on the surface can be calculated by multiplying the quantity of energy incident on a surface normal to the sun's rays by the cosine of the angle of incidence and adding in an estimated quantity for scattered radiation (7, 8). Hourly calculated quantities for for the twenty-first day of each month were integrated to secure daily totals.

Fig. 1 shows these daily totals for a horizontal surface at 30, 35, 40 and 45 deg north latitude during cloudless days. The curves would be for sea-level conditions and are in general agreement with the data presented by Threlkeld and Jordan (8). Fig. 1 shows that the horizontal surface intercepts a maximum of radiation in summer, with the amount being nearly equal for all four latitudes in late June and early July at about 2,650 Btu per (day)(sq ft). This near equality is explained by the fact that the effect of greater solar altitude near the middle of the day for southern latitude is counterbalanced by more daylight hours for northern latitudes. The more pronounced change for northern latitudes in the number of daylight hours from summer to winter explains the larger decrease in incident energy from summer to winter.

The optimum tilt angle for a stationary collector of solar radiation depends on the latitude and the seasonal demand. The daily total radiation incident upon a surface, for all practical purposes, will be a maximum if a south-facing surface is tilted so that the sun's rays are perpendic-

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December 1960, on a program arranged jointly by the Electric Power and Processing and Farm Structures Divisions, as ASAE Paper No. 60-819, and approved as Journal Paper No. 172 of the Wyoming Agricultural Experiment Station, Laramie.

The authors — C. F. BECKER and J. S. BOYD — are, respectively, professor of agricultural engineering, University of Wyoming, Laramie, and professor of agricultural engineering, Michigan State University, East Lansing.

*Numbers in parentheses refer to the appended references.

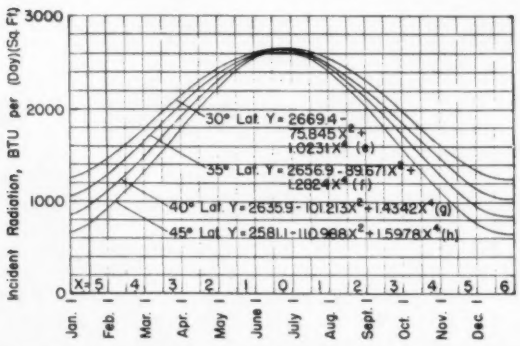

Fig. 1 Daily total direct and sky radiation incident upon a horizontal surface at various north latitudes during cloudless days

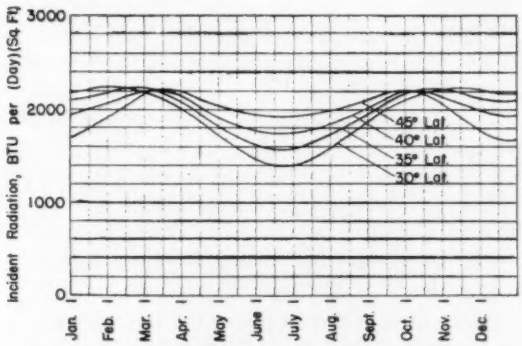

Fig. 2 Daily total direct and sky radiation incident upon a south-facing surface tilted 30 deg from vertical at various north latitudes during cloudless days

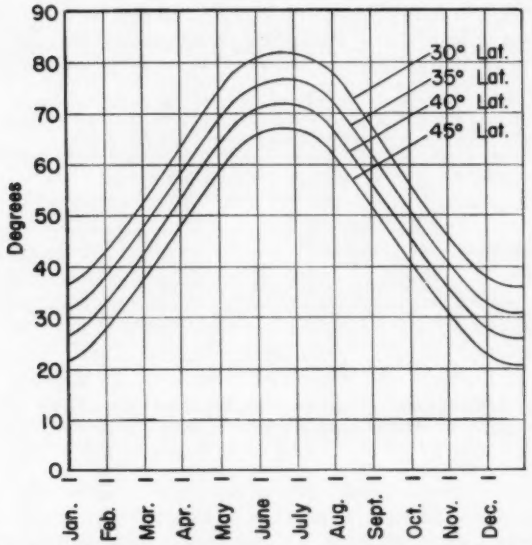

Fig. 3 Number of degrees to tilt a south-facing surface from vertical to make it perpendicular to the sun's rays at solar noon

ular to it at solar noon (Fig. 3). For winter time, this requirement would be fulfilled if the tilt angle from horizontal is 15 deg plus the latitude. Fig. 2 shows the daily total radiation incident upon a south-facing surface tilted 30 deg from vertical for the same four latitudes. The radiation incident on surfaces with other orientation is presented in another paper by the author (1). It is noted that the incident energy during spring and fall peaks at slightly

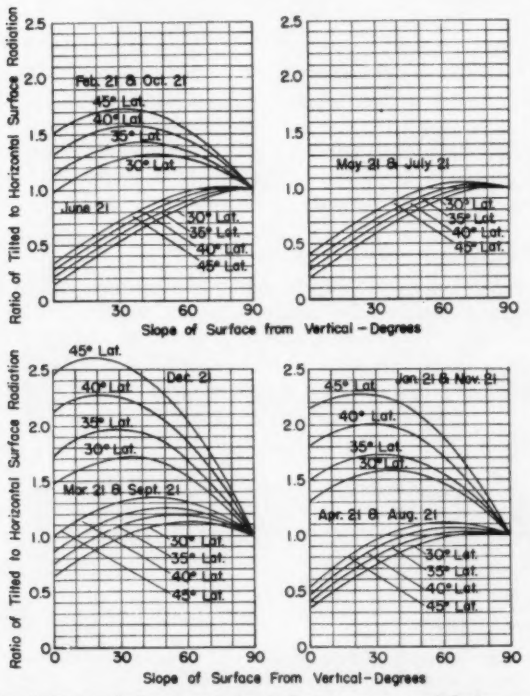

Fig. 4 Ratio of direct and sky radiation upon south-facing surfaces with various tilt angles to radiation incident upon a horizontal surface

TABLE 1. COEFFICIENTS OF THE POLYNOMIAL, $y=a+bX+cX^2$, FOR THE VARIOUS CURVES OF FIG. 4.

Date	Latitude	Coefficient		
		a	*b*	*c*
Dec. 21	30°	1.496	0.012657	−0.0002025
	35°	1.734	.014313	.0002502
	40°	2.132	.012366	.0002774
	45°	2.499	.010621	.0003033
Jan. 21 and Nov. 21	30°	1.322	0.014395	−0.0001999
	35°	1.510	.013339	.0002112
	40°	1.827	.013236	.0002500
	45°	2.154	.012117	.0002776
Feb. 21 and Oct. 21	30°	0.997	0.014531	−0.0001613
	35°	1.141	.015173	.0001860
	40°	1.312	.014250	.0001972
	45°	1.500	.013619	.0002139
Mar. 21 and Sept. 21	30°	0.638	0.016279	−0.0001361
	35°	.768	.015605	.0001445
	40°	.872	.015237	.0001532
	45°	1.011	.015365	.0001722
Apr. 21 and Aug. 21	30°	0.314	0.017447	−0.0001083
	35°	.400	.017659	.0001221
	40°	.492	.016878	.0001249
	45°	.571	.018014	.0001472
May 21 and July 21	30°	0.186	0.016350	−0.0000806
	35°	.244	.016964	.0000944
	40°	.345	.015827	.0000944
	45°	.399	.016884	.0001132
June 21	30°	0.105	0.016696	−0.0000744
	35°	.205	.016145	.0000805
	40°	.277	.016064	.0000889
	45°	.326	.017028	.0001055

more than 2,200 Btu per (day)(sq ft). The peaks are very nearly equal because the more favorable angle of incidence for northern latitudes is offset by more daylight hours and less depletion by the atmosphere for the southern latitudes.

Fig. 4 shows the ratio of tilted to horizontal-surface incident radiation. A polynomial, of the form $y=a+bX+cX^2$, was fitted by the method of least squares to each of the curves. X is the slope of the south-facing tilted surface in degrees from vertical and y is the ratio of tilted to horizontal-surface incident radiation. Table 1 shows a tabulation of the coefficients of the polynomial for various latitudes and seasons.

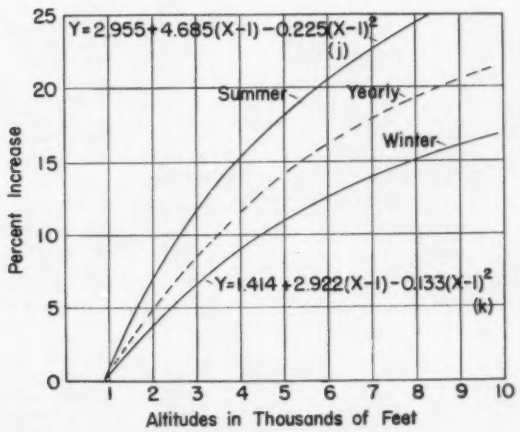

Fig. 5 Percentage increase of solar radiation intensity with altitude

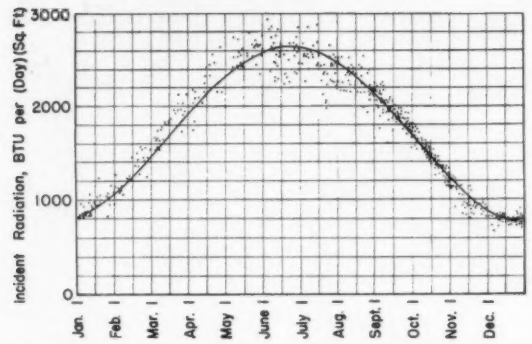

Fig. 6 Comparison between recorded and calculated direct and sky radiation incident upon a horizontal surface at Lincoln, Nebr., during days with 0 to 3/10 cloud cover, 1950 through 1954

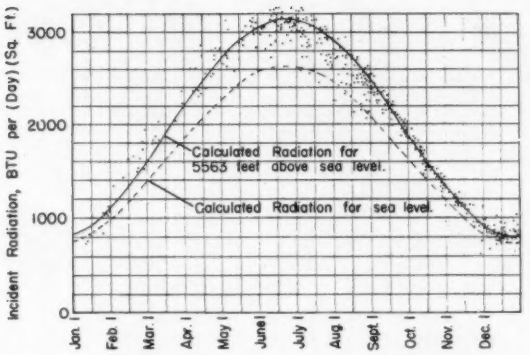

Fig. 7 Comparison between recorded and calculated direct and sky radiation incident upon a horizontal surface at Lander, Wyo., during days with 0 to 3/10 cloud cover, 1950 through 1954

The ratio of tilted to horizontal-surface incident radiation is useful because the U.S. Weather Bureau recording stations, which now number about eighty, measure only on the horizontal surface.

Intensity Variation with Altitude

The increase in solar-radiation intensity with altitude, with progress westward from the Atlantic Coast, is of interest, particularly in the Rocky Mountain region. The variation in the transmission of solar energy with altitude depends on the length of the path of the sun's rays, which vary with the season (5). Fig. 5 shows the percentage increase in solar-radiation intensity with altitude for December 21 and June 21 at 40 deg north latitude, based on the difference in the length of the path and the precipitable water.

Percentages for other times of the year can be approximated by interpolation between values given by the two polynomials for the respective curves. The validity of the use of these calculated availabilities is shown in Figs. 6 and 7.

Fig. 6 shows the comparison between calculated cloudless-day and recorded radiation on a horizontal surface at Lincoln, Neb., during days with 0 to 3/10 cloud cover. Fig. 7 shows the same information for Lander, Wyo., which is 5563 ft above sea level; the dashed line would be the calculated quantity for sea-level conditions. Comparisons for Madison, Wis.; Lansing, Mich.; Blue Hill, Mass. and Albuquerque, N. M., have also been made (1).

The effect of clouds on solar-radiation intensity can be determined by correlating the percentage of possible sunshine, for which long-time information is available at many places, with the ratio of measured to calculated cloudless-day radiation. The average annual percentage of possible sunshine has been published by the Weather Bureau (9). Fig. 8 shows the correlation between the ratio of mean daily recorded radiation to calculated cloudless-day radiation for four years of data from five U.S. Weather Bureau stations, based on the polynomials in Figs. 1 and 5 and on the percentage of possible sunshine.

The curves and polynomials presented can be used for approximating the average availability of solar energy. These approximations will be useful for making gross approximations of the energy supply in connection with various possible methods of utilizing solar energy.

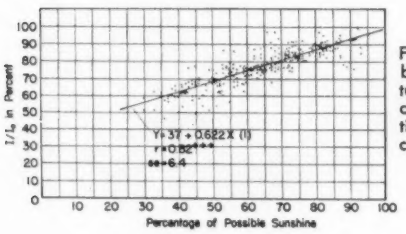

Fig. 8 Relationship between ratio of actual to calculated cloudless day radiation, I/I_o, and percentage of possible sunshine

Statistical Analysis of Data

If available, it is best to utilize solar-radiation data from measuring station for final engineering design. The data can be processed statistically to give the cumulative probability for various solar-radiation amounts. Fig. 9 shows the results of such a statistical analysis on three years' solar-radia-

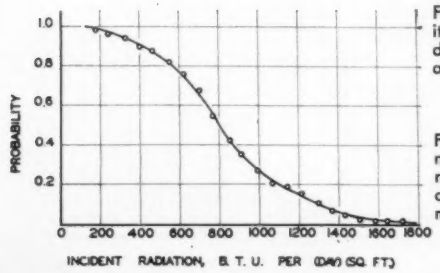

Fig. 9 *(Left)* Cumulative probability for daily solar radiation incident upon a horizontal surface at Laramie, Wyo., December, January and February

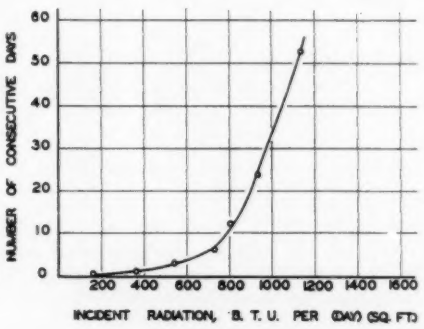

Fig. 10 *(Right)* Mean maximum number of consecutive days with radiation below specific values or a horizontal surface at Laramie, Wyo., December, January and February

tion data as measured on a horizontal surface at Laramie, Wyo., during the months of December, January and February.

The period selected would be the one to consider if solar energy is to be used for house heating or supplying supplemental heat in connection with ventilation of farm buildings. Fig. 9 indicates that one can expect the incident energy on a horizontal surface to be 800 Btu per (day) (sq ft) or more, 50 percent of the time and 560 Btu per (day) (sq ft) or more, 80 percent of the time. An approximation of the solar-energy availability for Laramie, Wyo. (41° 18′ latitudes, 7,200-ft elevation), using the polynomials in Figs. 1 and 5 and the linear equation in Fig. 8 for 70 percent of possible sunshine, gave 805 Btu per (day) (sq ft). For wintertime use, a collecting surface tilted 30 deg from vertical would be nearly optimum, in which case the expected incident radiation would be approximately twice as great as for the horizontal surface (Fig. 4).

For solar-radiation application such as house heating, where energy storage will be necessary, Fritz (2) suggests that a statistical analysis, which would give the maximum number of consecutive days with solar radiation below given values, would be useful. Fig. 10 shows the results of such an analysis on data measured on a horizontal surface at Laramie, Wyo., for three years during December, January, and February. In compiling this curve, the maximum number of consecutive days with radiation below specific values were averaged for the three years and plotted. It is noted that four consecutive days with radiation below 600 Btu per (day) (sq ft) would be expected. From Fig. 9 it can be determined that, for a heating system designed on the basis of 600 Btu per (day) (sq ft) on a horizontal surface, 24 percent of the day, or approximately 22 days during the three-month period, would require storage.

Alternatively, 68 days would supply the designed-for, or a surplus of, energy. It can be pointed out again that the energy incident upon a south-facing surface tilted 30 deg from vertical for the above discussion would be approximately 1200 Btu per (day) (sq ft).

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. . . Drainage Pumping Efficiency

(Continued from page 297)

In their design manual (3), the U.S. Corps of Engineers recommends 4 min for the design length of cycle. This applies to pumping stations that do not operate regularly, i.e., only during periods of surface runoff. In agricultural drainage this is true for some pumping plants, but those pumping subsurface water operate regularly.

Before making a general conclusion regarding the optimum design cycle, certain additional factors should be considered. First, one should recognize that the actual length of the pumping cycle varies with the rate of flow (1). The running time varies from a minimum of one-half the design value (for an inflow approaching zero) to infinity. Thus the average running time may actually be less than for the corresponding cycle length used in the tests, tending to reduce efficiency further. On the other hand, the greatest portion of the power may be consumed during brief periods of high inflow.

A second consideration is the relation of pump size to optimum cycle length. Using principles of hydraulic similarity to apply the test data to larger pumps, one finds that, for 8, 10 and 12-in. pumps, the cycle lengths shown in Fig. 2 and Table 3 should be multiplied by 1.15, 1.29 and 1.41, respectively. Differences in static lift will also occur. For 8, 10, and 12-in. pumps, the static lift used in the tests (4.66 ft) would be equivalent to 6.21, 7.77, and 9.32 ft, respectively. Values greater than these would give efficiencies lower than the cycling test data, and vice versa.

Conclusions

Several modifications in the current design of farm drainage pumping plants appear feasible, based on the results of these tests of a typical propeller pump. In most cases the changes will mean a saving in cost of construction without appreciably increasing the cost of operation.

Two means of reducing sump depth are shown to be possible from the standpoint of pumping efficiency. First, for a 6-in. propeller pump similar to the one tested, the combined submergence plus bottom clearance can be reduced about 9 in. Correspondingly larger reductions should be possible for larger pumps of the same type. Secondly, a small pump well can be placed below the floor of the main sump. Assuming hydraulic similarity, its diameter may be as small as three times the pump diameter. The submergence plus bottom clearance can then be provided for in the pump well rather than in the main sump, with a corresponding saving in sump depth.

On the basis of these test data and other information presented, the authors suggest a design cycle length of 4 to 8 min, depending on several factors. These would include the amount of operation, the pump diameter, the static lift and the cost of power. A median value of 6 min would undoubtedly be suitable for typical, regular service, farm drainage pumping plants. This is equivalent to 10 cycles per hour, which is twice the value previously suggested (1).

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INSTRUMENT NEWS

Transportable Fallout Detector

Measures Radioactivity on Farm Land

P. E. James
Member ASAE
and R. G. Menzel

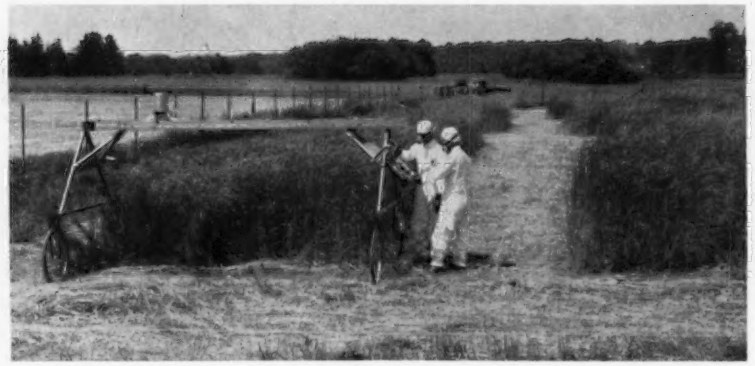

Fig. 1 Transportable fallout detector in use over rye

A RESEACH project is being conducted at Beltsville, Md., by soil scientists and agricultural engineers, sponsored by Atomic Energy Commission, to find effective means of removing atomic fallout from farm land. During the course of these AEC tests, artificial fallout is spread on growing crops and bare soil. The contaminated crop or top layer of soil is then removed and the activity remaining on the ground is again measured.

A transportable radiation monitor was made to detect the artificial fallout. It overcame many difficulties in measuring radioactive contamination on field plots and could be operated over many crops (Fig. 1). During early tests the activity was measured by removing soil samples before and after contamination and counting the activity in them. This was satisfactory on bare, rockless soil. However, difficulties arose when this method was used over growing crops. Much of the fallout remained on the plants and, therefore, could not be measured with soil samples. Other difficulties arose after removal of the crop. The stubble roots prevented easy removal of soil plugs. The soil core would not stick in the sampler when dry, sandy soil was used.

The new detector is mounted six feet above ground on two 12-ft aluminum beams on tandem bicycle wheels. The rear wheels are castered to make the equipment mobile. A lead-shielded sodium iodide crystal and photomultiplier tube, with a preamplifier, are mounted on a carriage. This carriage is moved between the aluminum beams by a crank (Fig. 2). A conical opening in the lead shield below the crystal admits radiation from a circle approximately three feet in diameter at ground level. The electric cable from the photomultiplier tube is extended over the equipment by a flexible car antenna. This allows the cable to follow the carriage without dragging in the contaminated crop. The

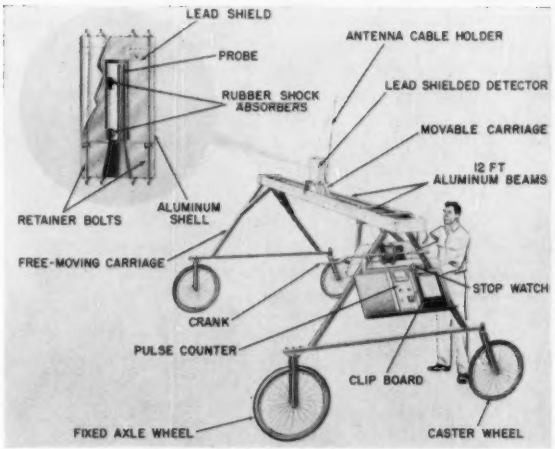

Fig. 2 Details of fallout detector

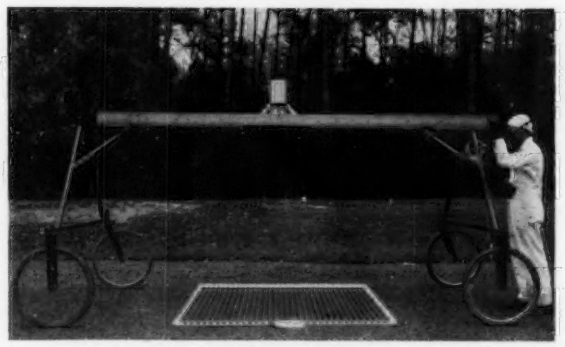

Fig. 3 Checking the detector with a known source

An Instrument News Contribution. Articles on agricultural applications of instruments and controls and related problems are invited by the ASAE Committee on Instrumentation and Controls, and should be submitted to Karl H. Norris, instrument news editor, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md.

The authors — P. E. JAMES and R. G. MENZEL — are, respectively, agricultural engineer and soil scientist (AERD and SWCRD, respectively) Agricultural Research Service, USDA, Beltsville, Md.

Acknowledgment: The authors gratefully acknowledge the assistance of Norman C. Teter, agricultural engineer, Livestock Engineering and Farm Structures Research Branch (AERD) and James F. McConnell, agricultural engineer, formerly with the Fallout Project (AERD), who contributed valuable suggestions on designing the instrument described in this article.

photomultiplier cable goes to a count rate meter at one end of the aluminum beams.

A standard source of gamma radiation was prepared for checking the performance of the detector from day to day, and also for studying radiation scattering and absorption in various crops. Cesium-134 was chosen as a radiation source because it is relatively long-lived and emits gamma radiation with nearly the same energy as Barium-140, which was used in many of the fallout studies. The Cesium-134 was adsorbed on the surface of glass beads. Thirty aluminum tubes were filled with the tagged glass beads. Each tube was 6 ft long, ½ in. in outside diameter, and contained 12 microcuries of activity. After filling the tube with the beads, a bakelite plug was hammered into it and a cap screwed over it. A 6-ft square aluminum frame was made to support the tubes beneath the detector (Fig. 3).

The detector is used by moving it over the area where the radiation is to be measured. This is done before and after the area has been decontaminated.

When the detector is moved from one location to another some distance away, the fixed axle wheels are turned 90 degrees to put the machine in a transport position. The lead-shielded probe is locked in position by a brake on the pulley shaft. After the detector is put in transport position, the front end is elevated. This allows the equipment to trail as it goes down the road.

. . . Plows and Computers

(Continued from page 295)

where $f''(t)=0$

$$g''(t)=2a_2+6a_3t$$

$$h''(t)=2b_2+6b_3t+12b_4t^2+20b_5t^3+30b_6t^4$$

and the *magnitude* of acceleration *(a)* is

$$|a|=\sqrt{[f''(t)]^2+[g''(t)]^2+[h''(t)]^2}$$

Utilizing the data sheets of the coordinates obtained in the laboratory, the computer, after being properly programmed, quickly established the resulting values (Fig. 5) of magnitudes of the acceleration and velocity of the point *P* moving over curves *A, B, C*. Fig. 6 shows the plot of two typical production plows. The curves marked *X* are the actions taking place on curve *A*. Those marked *I* correspond to curve *B* and those with no mark correspond to curve *C*.

With many years of field experience of both bottom No. 1 and bottom No. 2, and recent studies made with a tillage meter, we are well aware that bottom No. 2 is a better performer than bottom No. 1. Comparisons of the curves for bottom No. 1 and bottom No. 2 were quite helpful in analyzing and correlating some of the phenomena observed during recent studies with our tillage meter. The complete field program has not yet been fully evaluated; however, we feel confident that the computer has accomplished a considerable savings in time and money.

This paper is not intended as a thesis on plow bottom design *per se*. Many phases of the problem, including soil types, operating depth, etc., are not discussed. It is hoped, however, this discussion will indicate to engineers the adaptability of this new tool. The electronic computer is solving many of our more complicated problems where we formerly had to rely on the time-consuming empirical approach.

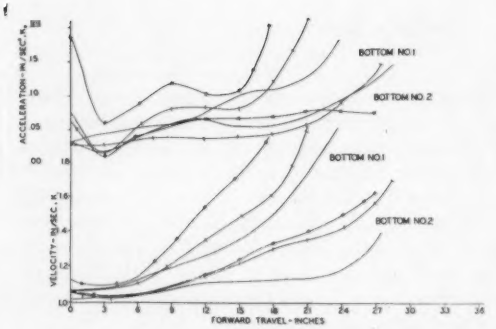

Fig. 6 Plot of acceleration and velocity data of production plow bottoms

Appendix 1. Milestones in Plow Development (7)

1788 — Thomas Jefferson applied mathematics to shape of moldboard.
1797 — Cast iron moldboard plow patented.
1837 — Steel plow industry began.
1864 — First successful two-wheel sulky, a riding plow.
1868 — Soft-center steel for plows developed.
1884 — First successful three-wheel sulky, a riding plow.
1899 — First foot-lift for plows.
1935 — Lift-type mounted plow introduced.
1941 — Hydraulic remote control for implements.
1953 — Safety-trip plow beams in use.

Appendix 2. Milestones in Mechanical Computers

— Abacus
1650 — First attempt to build digital computer, by Charles Babbage.
1850 — First patent on key-driven desk calculator.
1859 — Ten-inch Mannheim slide rule invented.
1887 — Patent on a key-driven calculator which was later to become the comptometer.
1930 — Differential analyzer, first practical analog computer.
1944 — Automatic sequence-controlled calculator, first practical digital computer.
1946 — "ENIAC," electronic calculator.

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. . . Public Relations

(Continued from page 291)

There are more workers engaged in agriculture than there are in the automobile manufacturing industry, more workers than are employed by all the transportation and public utility businesses in the country combined. Total physical and financial assets of agriculture exceed 200 billion dollars, nearly nine-tenths of which is free from debt claims. That 200 billion is at least three-fourths the market value of all the stocks on the New York Exchange, and equals about three-fourths the assets of all the manufacturing corporations in the country.

Of course, as you gentlemen well know, the investment per worker in agriculture is higher than it is in the manufacturing industries — more than $20,000 compared to $17,800. Then too, the public in general does not realize that this is a tremendous growth industry. During the 1950s the output per worker in agriculture increased about 9 percent a year which compares with 2½ percent in the non-farm industries. That is one to be proud of!

The steady decline in number of farmers and of farms simply means that farms are moving into more efficient hands and that fewer farmers are sharing an increasing income.

One will run into some curious things in watching what public reaction to farming is. The other day while participating in my wife's shopping — my participation is pushing the cart — there was a lady who exclaimed, as she set her bags into the cart to carry out to the car, "My isn't food expensive!"

"Well," I said, "What do you have in those bags?" By the time we checked all the items from her list we found out that she had spent nearly as much for items that had nothing whatever to do with food as she had for the food items. And if we had been able to separate the money she had paid for conveniences that were built into these foods, her cost of food would have been even smaller than she thought. Then she sighed after having been convinced, at least for that moment, that food wasn't so high and said, "Mr. McMillen, shopping is an awful nuisance." And I said, "My dear I might agree with that, but producing all this stuff that you bought is considerable effort too."

We do pretty well by that lady and by all the others who buy food. Not in many, many decades has the average American family been able to supply itself with food for so small a percentage of its disposal income — a percentage that is now only about twenty percent; in other words, about one dollar out of five has to go for food for the average family. And, of course, when we compare that with what goes on in the rest of the world, we see the Japanese worker spend forty-two percent of his income for food; in West Germany it's forty-five percent; and in this great power of Russia, in which we seem to be so much interested, the average worker has to spend fifty-six percent of his income for food in order to live.

Now, not everything is as we would like it to be on the agricultural front, as can be easily seen in the fact that the cost of food, in the so-called average family market basket, in the last ten or twelve years has gone up 12 percent while the farm value of that same food has gone down 14 percent. Maybe we ought to explain that a little more fully to our public. Our consuming public doesn't realize that sometimes the milkman gets paid more for bringing the bottles to the doorstep than the farmer got for owning, feeding and milking the cows.

There are some things, too, that can't be found on the agricultural front that can be found in other places; and if there were ways to do it, I wish we could show people more about them. You go up and down the rural routes of America and look to see what farmers have to sell and you will not find any items that have fair-trade prices tacked on to them. They are not sold that way. You will find no apprentice farmers chosen in order to limit the number of people engaged in farming. Nowhere will you find it necessary to pass a state board examination or take out a license in order to become a farmer. We have no equivalent to the National Labor Relations Board to decide that if a majority wants to do a certain thing, the rest of us must do it. We have no laws that compel anyone to pay a fixed price. We have no closed shop in agriculture, and no one in America ever needs to go hungry.

I think of a few things that farmers do resent and do actually wish the world understood a little better. I am confident that almost any farmer resents being regarded as a dependent of the government. Most farmers are not. Only about twenty-three commodities produced by farmers, out of more than 250 agricultural products, are or have been price-supported; about two dozen out of ten times that many. Then, farmers resent, and I am sure your conversations with them would incline to lead you to agree, something we have not yet found anything to help: that is the apparent necessity to hang on to the tail end of the economic kite. The raw material producer is not too well equipped to bargain for his prices. But farmers themselves are doing some things about that, and one of the spectacular developments in agriculture in the next ten or twenty years may be an increasing control by farmers of their own bargaining power.

Farmers, of course, don't like the idea of hearing as much as they do about being subsidized. It would be fortunate if there were more channels through which answers could be given. It is, of course, no particular answer to say that other people are subsidized too, though the principle is the same.

After all, for generations the farmers of America have had to subsidize the cities. They subsidized the cities and their industries with cheap food that very often did little more than repay the cost and hardly repaid the wages of those who produced it. We subsidize the cities with well-trained, capable and frequently well-educated young people who cost us in the rural communities roughly about two-thousand dollars each to educate and bring up to a point where they are ready to leave the farm and go to contribute their capabilities to the development of non-farm activity. Then, of course, farmers pay their share of the subsidies that go for urban renewal and for air transportation, airports and things of that sort.

If we have a public relations problem in agriculture, or at least a public relations opportunity, who should do something about it? Is it your job? Whose is it? There seems to be only one possible answer. There is an opporunity for anyone who sees a place where he can help. It is a job that farmers themselves ought to be doing more about in their day-to-day communications face to face and otherwise with non-farm people. It would pay many of the farm-

related industries — perhaps some of yours — to undertake this problem more seriously. You may have in your organization trained public relations specialists who could bring good will to your companies by doing a little more to inform the public of facts about agriculture. In fact, I suspect it would be better done, more thoroughly done, if we could have some kind of a group of such professionals with a program they would follow through. Then, some may ask, since our customers can't abandon us, why should we bother about any public relations? In a self-governing republic it is highly important that people should have facts to think by and facts to vote by. We should make no mistake that might lead to a time when this agriculture of ours, now in the hands of the greatest body of independent businessmen in America, could cease to be independent. We must make certain that government shall never be able to intrude so far that those who produce and those who purchase our food shall not make decisions for themselves. After all, there is one thing, gentlemen, that may be said to be almost as important to us as food, and that is freedom in America. We haven't proved yet for all time that we can keep it. We have seen a little of it slip out of our hands occasionally from time to time, and it's hard to recover.

I shall now say something some of you may have heard me say before in the same way. There is no idea that is fundamentally more basic to your future and the future of your children, and to the outlook of our country, than that we must be eternally vigilant in the defense of freedom.

This is a young country. Let me see if we can't sharpen that point a little. Just look around you a minute, if you will, and see if you can find three men who are about 61 years old. Now, multiply 61 by three! What do you get? One-hundred and eighty-three. This is 1960. Subtract that 183 from 1960, and you get 1777, right back there close to the Declaration of Independence and to the winter of Valley Forge. Just three short lifetimes since our national beginnings. Just three short lifetimes from December 6, 1960, here in Memphis to those days in the very beginning of the republic when men pledged their lives and their fortunes and their sacred honor. That has been long enough to prove that freedom, that individual liberty, that the right to choose what we enjoy in America, have really worked, but it hasn't been long enough to prove that we can keep them. And all history tells us that we have had the constant struggle between tyranny on the one hand and freedom on the other. What have we done in this very brief 180 years? Back there we were not quite four million people scattered up and down the Atlantic seaboard. Now we are a nation of 180 million. We have plowed the continent from coast to coast. We have laced it with railways and highways and airways and "wireways." We have built it up with prosperous cities and lovely villages. We have built enough schools and enough churches and nearly enough hospitals to take care of everybody as human beings have never been taken care of before. We hope that we shall be able to keep on expanding the well-being of America, and to maintain our position of being able to help our less fortunate brothers across the sea. Much of that hope depends upon what happens in American agriculture. Much of the hope for the rest of the world depends upon what happens in foreign agriculture, because no underdeveloped country is going to be able to build its industry and build its standard of living until it learns, too, to feed itself. So perhaps the hope of peace, which we all cherish, has something to do with this basic problem of public relations in agriculture, something to do with the determination that we shall maintain in agriculture, maintain in industry, maintain in professions, this basic thing that has made America so great: the right of the individual to choose.

Did you ever stop to think that in 1789, when we began to organize this nation under the new constitution, we were an underdeveloped country? We were not only an underdeveloped country, but there was no Uncle Sam anywhere to extend us aid. We didn't need it, because our people had the right to choose, and Americans never had to go hungry. Agriculture is basic; freedom is absolutely fundamental. Thank you, my engineer friends, for listening to me so long.

Correction

TO THE EDITOR:

PAGE 222 of the May 1961 issue of AGRICULTURAL ENGINEERING contains the following statement with reference to indehiscent sesame: "With the finding in Venezuela by a USDA plant geneticist of a lone sesame plant having exceptionally tough pods . . . in extensive breeding work."

The statement is an error in fact; the actual discoverer was neither a member of the USDA nor a scientist. To give credit where credit is due, the lone indehiscent plant was found in the F5 generation of a cross between the variety Criollo and Selection 5 by a field foreman for Dr. D. G. Langham of the genetics department of what is now the Venezuelan Institute of Agronomic Investigation. This discovery, which made possible the great advances in combinable sesame by South Carolinians, Texans, and Venezuelans, was reported in 1947 as follows:

Langham, D. G., and Maximo Rodriguez. 1947. Abrete sesamo. Circ. 17.

Departmento de Genetica, Direccion de Agricultura, Maracay, Venezuela.

Dr. Langham is a native American.

J. R. ORSENIGO

Assistant horticulturist
Everglades Experiment Station
University of Florida

1961 TRANSACTIONS of the ASAE

THE General Edition of the 1961 TRANSACTIONS of the ASAE, Vol. 4, No. 1, containing 152 pages is off the press. Copies are available at $6.00 each ($3.25 to ASAE members). The second edition, containing at least 96 pages, will be a special edition devoted to technical articles on Power and Machinery subjects and will be published later in the year. Copies of the special edition will sell for $4.00 each ($3.00 to ASAE members). Combined price for both editions is $8.00 ($5.50 to ASAE members).

Finance Committee Meets

The ASAE Finance Committee met at the Society headquarters in St. Joseph, Mich., May 26. Members present were E. D. Anderson, chairman, F. A. Lyman, and L. H. Ford. C. S. Morrison (new member designated by President-Elect Byron Virtue) and A. W. Farrall, new president-elect, were also present at the invitation of Chairman Anderson.

A meeting of this Committee is regularly held at this time of year in preparation for its report and recommendations to the Council during the Society's Annual Meeting.

Items of business considered during the committee meeting included a review of the auditor's report on the Society's accounts for 1960; the Society's financial outlook for 1961; recommendations in the Society's "Program for Progress"; financial aspects of the Agricultural Engineering Exposition to be held in conjunction with the Winter Meeting; financing the Annual Meeting; insurance carried by the Society; possibilities for encouraging grants, endowments, and bequests; office improvement; and publication financing.

Land-Grant Centennial

The 68 Land-Grant colleges and universities in the 50 states and Puerto Rico are preparing to celebrate the centennial of the act that brought this system of higher education into existence. This law — the Morrill Act — was signed by President Abraham Lincoln on July 2, 1862. This act was significant for two reasons: First, it embodied the then revolutionary idea that everyone with the ability to absorb a higher education should have the chance to attend college; second, it provided the incentive on a national scale to bring this concept of equal educational opportunity to life. The colleges and universities will observe this anniversary with a program of events which will occur throughout the school year of 1961-62. Centennial Committee Chairman R. A. Harvill, president, University of Arizona, states that it is the Committee's intention to employ the commemorative period for substantive purposes — namely, a hard look at where we stand now and some forward planning to meet our future obligations. The past will be reviewed only to the extent of helping to identify today's problems in higher education and provide a guide as to how those problems can be solved in the world of tomorrow.

BULLETIN

A special invitation has been extended by President L. W. Hurlbut to all members attending 54th Annual Meeting at Ames, Iowa, to attend the Cabinet Meeting in Memorial Union, Council Chamber at 8:00 p.m., Sunday, June 25.

President Hurlbut has announced that he would like to see a large attendance at this important meeting which provides an excellent opportunity for open discussions on all society matters concerning individual members, the sections and the national organization.

Institute for the Certification of Engineering Technicians

The National Society of Professional Engineers has authorized the establishment of an Institute for the Certification of Engineering Technicians. The purposes of the Institute are: (1) To elevate the performance standards of engineering technicians as an important part of the engineering team; (2) to determine the competence of engineering technicians through investigations and examinations to test the qualifications of voluntary candidates for certificates to be issued by the Institute; and (3) to grant and issue certificates to engineering technicians who voluntarily apply and to maintain a registry of holders of such certificates.

ASAE members played important roles in the Cairo International Agricultural Exhibition, March 25 to April 30. Left to right are: J. T. Phelan, irrigation engineer with SCS in Lincoln, Nebr.; I. F. Reed, agricultural engineer of the USDA National Tillage Machinery Laboratory, Auburn, Ala.; and A. R. Robinson, hydraulic engineer with ARS and the Colorado Agricultural Experiment Station, Fort Collins, Colo. Mr. Phelan manned a model farm water-management display; Mr. Reed had charge of 40 pieces of farm machinery; and Mr. Robinson conducted demonstrations in irrigation at a 120-ft irrigation exhibit. All three conducted seminars in their fields for the benefit of the Egyptian engineers and scientists

The Institute is an examining and certifying body only, which will determine qualification for three classes of technician upon voluntary submission of credentials by a person seeking such recognition. It is not another technical society, nor is it a class of membership in NSPE. It is emphasized that persons engaged in the practice of engineering are excluded from consideration, since matters in the professional realm fall under the jurisdiction of the various state boards of engineering examiners. To make certain no confusion will exist each certificate will carry a statement to the effect that such certification does not constitute a license to practice engineering.

EVENTS CALENDAR

June 25-30 — *American Society for Testing Materials Annual Meeting,* Chalfonte-Haddon Hall, Atlantic City, N.J. Write to ASTM headquarters, 1916 Race St., Philadelphia 3, Pa., for information.

June 26-28 — *68th Annual Meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers,* The Denver Hilton Hotel, Denver, Colo. Obtain information from ASHRAE headquarters, 234 Fifth Ave., New York 1, N. Y.

June 26-30 — *Annual Meeting American Society of Engineering Education,* University of Kentucky, Lexington. Details may be obtained from ASEE headquarters, University of Illinois, Urbana.

June 28-29 — *Second Annual Central Illinois Farm Materials Handling Days,* Exposition Gardens, Peoria, Ill. For details contact Agricultural Extension Service, University of Illinois, Urbana.

July 4-7 — *27th Annual Meeting of The National Society of Professional Engineers,* Olympic Hotel, Seattle, Wash. Details may be obtained from NSPE headquarters, 2029 K St., N.W., Washington 6, D. C.

July 10-14 — *Institute in Technical and Industrial Communications,* Colorado State University, Fort Collins. Contact the Director, ITIC, Colorado State University, Fort Collins.

July 19-20 — *National Farm Fire Safety Seminar,* Thor Research Center for Better Farm Living, Huntley, Ill. Write to Thor Power Tool Co. for information.

July 23-29 — *National Farm Safety Week.*

July 30-August 2 — *16th Annual Meeting, Soil Conservation Society of America,* Purdue University, West Lafayette, Ind. Further information may be obtained from SCSA headquarters, 838 Fifth Ave., Des Moines, Iowa.

August 1 – September 12 — *International Course on Irrigation, Subtropical Regions,* Irrigation Extension Centre of the Ministry of Agriculture, Ruppin Institute of Agriculture, Emek-Hefer, Israel. Information may be obtained by writing to J. Noy, director, Ministry of Agriculture, Irrigation Extension Center, Post Hamidrasha, Le'Haklaut, Emek-Hefer, Israel.

August 7-11 — *Third Annual Western Resources Conference,* Colorado State University, Fort Collins. Information may be obtained from Colorado State University.

10th Annual Hydraulics Conference

The 10th annual Hydraulics Conference, sponsored by the Hydraulics Division of the American Society of Civil Engineers, will be held August 16-18 in Urbana, Ill. The co-hosts are the University of Illinois and the Central Illinois Section of the American Society of Civil Engineers. The six half-day technical sessions will feature papers in the fields of ground water hydrology, surface water hydrology, hydrometeorology and flood control, hydraulic structures, sedimentation, and hydromechanics. Featured speakers will be W. H. Wisely, executive secretary of the American Society of Civil Engineers, who will discuss "Society Affairs" at the August 16 conference luncheon, and F. E. Dominy, commissioner of reclamation, Bureau of Reclamation, U.S. Department of Interior, who will give the August 17 evening banquet address on a subject of timely interest to hydraulic engineers and their wives. Activities of special interest for the ladies and children are also planned. Additional information may be obtained by writing to J. M. Robertson, professor, 125 Talbot Laboratory, University of Illinois, Urbana.

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D. R. Dahnert

D. E. Washburn

K. H. Gorham

H. J. Hansen

L. E. Campbell

B. E. Romig

Duane R. Dahnert has accepted the position of agricultural engineer in the agricultural extension department of Stran-Steel Corp., Detroit, Mich. In his new position, he will work with the corporation's building dealers and agricultural customers on the development of complete building systems for beef, dairy, hog, poultry and crop production enterprises. He received a B.S. degree in agricultural engineering from the University of Wisconsin in 1948, after which he worked for several years for the Public Service Co. of Northern Illinois, as agricultural sales engineer. Prior to joining Stran-Steel, he was a partner of Waterman Electric, a consulting service, in Waterman, Ill.

D. E. Washburn has been appointed vice-president and general manager of the Superior Metalware Division of John Wood Co. His new duties will be in addition to his position as vice-president and general manager of the company's Agricultural Equipment Division. He previously was employed for 12 years by United Cooperatives, Inc. (Alliance, Ohio) as manager of its farm mechanical department.

Karl H. Gorham has been appointed publisher of *Electricity On The Farm* magazine. He has been associated with the magazine as advertising and business manager since its founding in 1927. A graduate of Union College, Schenectady, N. Y., he worked for General Electric Co. before joining the magazine staff.

Hugh J. Hansen has been promoted to editorial director of *Electricity On The Farm* magazine, where he will be in charge of all editorial policies for the magazine. He joined the magazine staff as associate editor in 1955 and has been its editor since 1956. He received a B.S. degree in agricultural engineering from North Dakota State University and an M.S. degree in agricultural engineering from Cornell University. He is the current chairman of the ASAE Electric Power and Processing Division, and is also president of the Farmstead Council.

Lowell E. Campbell, head, instrument investigations, Farm Electrification Research Branch, AERD, ARS, USDA, Beltsville, Md., recently was elected chairman of the District of Columbia Council of Engineering and Architectural Societies for the year 1961-62.

Bernard E. Romig, first lieutenant in the U.S. Army and commanding officer of Engineer Float Bridge Company, 2nd Armored Division, Fort Hood, Texas, recently received a National Science Foundation Cooperative Graduate Fellowship for study at Cornell University. He will start work on an M.S. degree in agricultural engineering in September of this year. He received a B.S. degree in agricultural engineering from Iowa State University in 1959.

Herbert S. Hinrichs, assistant secretary and assistant treasurer, Kansas Power and Light Co., Topeka, Kans., has retired after spending 35 years in rural electrification in Kansas. He was born August 31, 1895, in Joliet, Ill., and received a B.S. degree from the University of Illinois in 1918. After graduation and until he was inducted into the Army he was a member of the University of Illinois staff. Upon completion of his Army service during World War I, he joined the Holt Manufacturing Co., Peoria, Ill. He served this company as agricultural engineer, assistant service engineer, and sales engineer. In 1925 he joined Kansas State University as a field engineer in the Engineering Experiment Station. A short time later he accepted employment with Kansas Power and Light Co., where he remained until his recent retirement. During the past 10 to 12 years, a part of his assignment with KPL was working with the experimental development of the heat pump and its applications to agriculture. The application to the farm home subsequently led to his obtaining considerable experience with electric heat in general.

Mr. Hinrichs has been an ASAE member since 1926. His retirement plans include some part time activity in the field of electric heat, as well as some traveling. Since retirement he has returned to his native state of Illinois to reside.

James A. Miller, director of engineering, Motec Industries, Inc., Hopkins, Minn., has been appointed vice-president in charge of engineering research and development. He began his engineering career in 1942 and joined Motec Industries in 1959. He holds numerous patents in the fields of automotive, materials handling, farm and construction equipment.

Ernest W. Revels, Jr., zone manager, Florida Ford Tractor Co., Winter Haven, Fla., is the first recipient of a scholarship to better acquaint an outstanding zone manager with the activities of Ford Motor Company's Tractor and Implement Division. Mr. Revels received the award at the company's 1961 Honor Council dinner on April 21 at Dearborn, Mich. It consists of an expense-paid nine-week period at division installations in Birmingham and Highland Park, Mich., and Des Moines, Iowa. Standards used to select him as the winner included: Dealer improvement, creativity, personnel recruitment, and progress in self-development.

Biswa N. Ghosh recently has been accepted as an associate member of the Institution of Agricultural Engineers. He is located in Nairobi, Kenya, Africa, where he is agricultural research engineer with the East African Industrial Research Organization.

Walter L. Moss has accepted the position of agricultural engineer with Duke Power Co., Salisbury, N. C. He previously had been engaged in farming and was associated with J. I. Case Co. as credit supervisor.

Phil Norton, executive vice-president, Wisconsin Motor Corp., Milwaukee, Wis., recently has been elected vice-president of the Internal Combustion Engine Institute.

Ronald J. Hartmann, formerly a research engineer with Caterpillar Tractor Co., has accepted the position of senior process engineer with Plax Corp. in Ligonier, Ind.

R. J. McCraney has been promoted from rural sales engineer in the Columbus Division of Georgia Power Co. to assistant manager of its Albany district, having served the Columbus Division for nine years. He received a B.S. degree in agricultural engineering from Auburn University and an M.S. degree in agricultural engineering from the University of Georgia. **J. C. Lumsden** has taken over Mr. McCraney's position in the company's Columbus Division. He previously served Georgia Power as residential sales engineer at Tifton and as district sales engineer at Manchester.

Allan W. McCulloch is now located in Ahwaz, Iran, where he is chief engineer for the Dez Irrigation Project of the Development and Resources Corp. He previously was chief irrigation engineer with W. R. Ames Co., Milpitas, Calif.

Elmer E. Jones, Jr. has been transferred from the USDA Soil Conservation Service, Rocky Ford, Colo., to the USDA Livestock Engineering and Farm Structures Research Branch. His work is concerned with the supply, use, and disposal of water in livestock and farmstead operations, and he is located at Shriver Laboratory, University of Maryland.

Elmer M. Alderman, factory service representative, Caterpillar Tractor Co., has been transferred from Phoenix, Ariz., to Fresno, Calif.

Peter R. Attwood advises that he has completed requirements for a Ph.D. degree from Edinburgh University and has accepted the position of executive engineer for marketing, Caltex (Africa) Ltd., in Nairobi, Kenya, Africa. He formerly was senior lecturer in engineering and surveying at Egerton Agricultural College, Njoro, Kenya.

Correction. The item in the April issue concerning the appointment of Robert L. Nichols as editor of the southwest edition of *Electricity On The Farm* magazine erroneously listed Reuben H. Donnelley Corp. as publisher of *Farm and Ranch* magazine. The publisher of *Farm and Ranch* magazine is Farm and Ranch Publishing Co.

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Michigan Section

The spring meeting of the Michigan Section was held May 12 at Jackson. The program included a tour of the Telecon Control Division of Hancock Industries, Inc., followed by registration and a technical meeting at Holiday Inn. This session consisted of a discussion on epidemiological approach to farm safety, by R. G. Pfister, agricultural engineering department, Michigan State University; a presentation by A. H. Willis, dean, College of Engineering, University of New South Wales, Australia, entitled "The Engineering College and Industry — Australia"; and a discussion on agriculture in Brazil, by Otis C. Cross, agricultural engineering department, Michigan State University (formerly agricultural engineering advisor with ICA, Rio de Janeiro, Brazil). The program concluded with a 6:30 dinner at which President L. W. Hurlbut was the featured speaker. The officers for 1961-62 installed at the dinner are: B. G. Elliott, chairman; F. H. Buelow, vice-chairman; B. J. Lamp, vice-chairman; R. W. Wilson, vice-chairman; and R. A. Aldrich, secretary-treasurer. Bridge games were enjoyed by the ladies, who did not wish to attend the technical session.

Pennsylvania Section

The Pennsylvania Section initiated a new series of regional meetings this spring rather than one large meeting with the hope that reduced time and travel to attend one of these new spring dinner meetings would bring out members who heretofore were only occasional participants in Section activities.

An eastern Pennsylvania spring dinner meeting was held at the Dutch Town and Country Inn near Lancaster on Friday, April 28. Members and guests totaled 63 at this meeting. The feature of the evening was a presentation on Pennsylvania Dutch humor, songs, and folklore by Dr. K. Frey of Franklin and Marshall College.

The western Pennsylvaina spring dinner and field trip was held on Wednesday, April 26. A tour of the farms of Glenn

(Continued on page 316)

(At Right) Installation of new Section officers was held during May 12 meeting of Michigan Section. Left to right are: R. A. Aldrich, secretary-treasurer; F. H. Buelow, vice-chairman; R. C. Frevik, retiring chairman; B. G. Elliott, chairman; R. W. Wilson, vice-chairman; and B. J. Lamp, vice-chairman

(Above) ASAE President, L. W. Hurlbut, shared the lectern during Michigan Section meeting with A. H. Willis • *(Right)* dean of the College of Engineering of the University of New South Wales, Sydney, Australia, who is visiting and studying at Michigan State University for a period of six months

The spring meeting of the Central Illinois Section was held at the agricultural engineering department of the University of Illinois on May 6, at which guests were high school students interested in agricultural engineering. Pictured at top is a group of 30 high school students who attended. *(Center)* Dean F. Hopkins, who is studying toward a Ph.D. degree, explains his project on high-pressure injection of liquid fertilizers to one group. *(Bottom)* New and retiring Section officers are from left to right: A. J. Muehling, past secretary-treasurer; K. E. Fuller, past-chairman; J. H. Thomas, vice-chairman; L. O. Stoeber, vice-chairman; D. R. Hunt, secretary-treasurer; E. F. Randolph, chairman-elect. J. H. McCavitt, vice-chairman, was not present when the picture was taken

(Above) Section officers pose following recent Southwest Section meeting. Left to right are A. J. Rhodes, vice-chairman; E. D. Wilborn, chairman; and J. L. Gattis, retiring chairman. G. L. Nelson (not shown) is the new secretary-treasurer

(Above) A tour of the Glenn Gongoware and Ed Phillips farms preceded the dinner meeting of the western portion of the Pennsylvania Section on April 26. The group shown touring the Phillips farm are from left to right: R. S. Crist (Section vice-chairman) Jack Nehoda; N. G. Patel; P. M. Anderson; Hal Branaka; Carl Spade; Mr. Phillips (co-host); D. E. McCandless; N. H. Wooding, Jr.; M. D. Shaw; Ed Phillips (host); and W. L. Kjelgaard (Section chairman).

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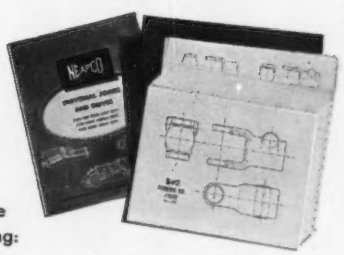

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(Left) Left to right, C. F. Becker, head, agricultural engineering, University of Wyoming and retiring Rocky Mountain Section chairman, shows his pride as his Section's excellent, well-planned program is reviewed by J. L. Butt, ASAE executive secretary, H. T. Person, dean, College of Engineering, University of Wyoming, and L. W. Hurlbut, chairman, agricultural engineering department, University of Nebraska, and ASAE national president. The meeting was held April 14 and 15, at the University of Wyoming in Laramie. *(Right)* Four of eleven program speakers discuss a new low-cost irrigation structure. The speakers are, left to right, N. W. Hilston, dean, College of Agriculture, University of Wyoming; C. E. Israelson, agricultural engineer, University of Utah; N. A. Evans, head, agricultural engineering department, Colorado State University; and A. W. Cooper, director, USDA, National Tillage Laboratory, Auburn, Ala.

. . . With ASAE Sections

(Continued from page 314)

Gongoware and Ed Phillips preceded the dinner meeting at the Adams House in Adamsburg. Sixteen members and guests were present. The dinner program featured Paul Nylander, state engineer, Soil Conservation Service, who spoke on flood control work in Pennsylvania under Public Law 566.

Washington, D. C. - Maryland Section

The Washington, D. C.-Maryland Section held its usual monthly luncheon meeting on May 12 in the USDA South Building, Washington, D. C. There were 46 in attendance, including approximately 10 guests. Three of the guests were agricultural engineering graduates stationed with the Army at nearby Fort Detrick, Md. Other guests were agricultural representatives from several of the embassies, including Great Britain, Australia, South Africa, and Indonesia. G. M. Cairns, dean of agriculture, University of Maryland, was the featured speaker. He addressed the group on the subject of the changing agriculture, with particular reference to conditions in Maryland.

A luncheon meeting was scheduled for June 9 at Log Lodge, Agricultural Research Center, Beltsville, Md.

Minnesota Section

The newly elected officers of the Minnesota Section for 1961-62 are: M. L. Gustafson, chairman; R. E. Larson, first vice-chairman; E. C. Meyer, second vice-chairman; B. E. Ryberg, third vice-chairman; M. H. Giese, secretary-treasurer; and J. M. Pomroy, editor.

Rocky Mountain Section

The annual meeting of the Rocky Mountain Section was held April 14 and 15 on the campus of the University of Wyoming at Laramie. There were 64 in attendance, representing the states of Colorado, Utah, New Mexico and Wyoming, with speakers coming from various parts of the country. ASAE President Lloyd W. Hurlbut gave the keynote address and A. W. Cooper, director of USDA National Tillage Machinery Laboratory, Auburn, Ala., was the speaker at the annual dinner. J. L. Butt, executive secretary of ASAE, reported ASAE news to the group. The Section's annual student paper awards were presented to: John Cannon of Utah State University, first place, for his paper on "Cantilever Construction in Farm Sheds Reduces Columns and Costs"; Ronnie Rickard, of the University of Wyoming, second place, for his paper on "The Economy of Lining Irrigation Ditches"; and Loren Maxey of Colorado State University, third place, for his paper on the "Investigation of Variable Factors in Vertical Augering." Cash prizes for winners were donated by interested industries. Elected to serve the Section for the coming year is the following slate of officers: A. R. Robinson, chairman; C. W. Lauritzen, vice-chairman; and J. L. Dirnberger, secretary-treasurer.

ASAE MEETINGS CALENDAR

June 25-28—ANNUAL MEETING, Iowa State University, Ames, Ia.

June 26 — BATON ROUGE SECTION, Agricultural Engineering Auditorium, Louisiana State University, Baton Rouge.

August 20-23—NORTH ATLANTIC SECTION, University of New Brunswick, Fredericton, N. B., Canada.

October 18-20 — PACIFIC NORTHWEST SECTION, Boise Hotel, Boise, Idaho.

October 20-21 — PENNSYLVANIA SECTION, Pennsylvania State University, University Park.

December 12-15 — WINTER MEETING, Palmer House, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

Chicago Section

The Chicago Section met on June 5 in the Wabash Parlor of the Palmer House, Chicago. A 6:00 p.m. dinner preceded the meeting and program. The group was addressed by Fred J. Steffens, vice-president of Cadillac Associates, on the subject of what makes a career go and how to make yours go better in his talk entitled "What's It Like Up There . . . And How Do You Get There?"

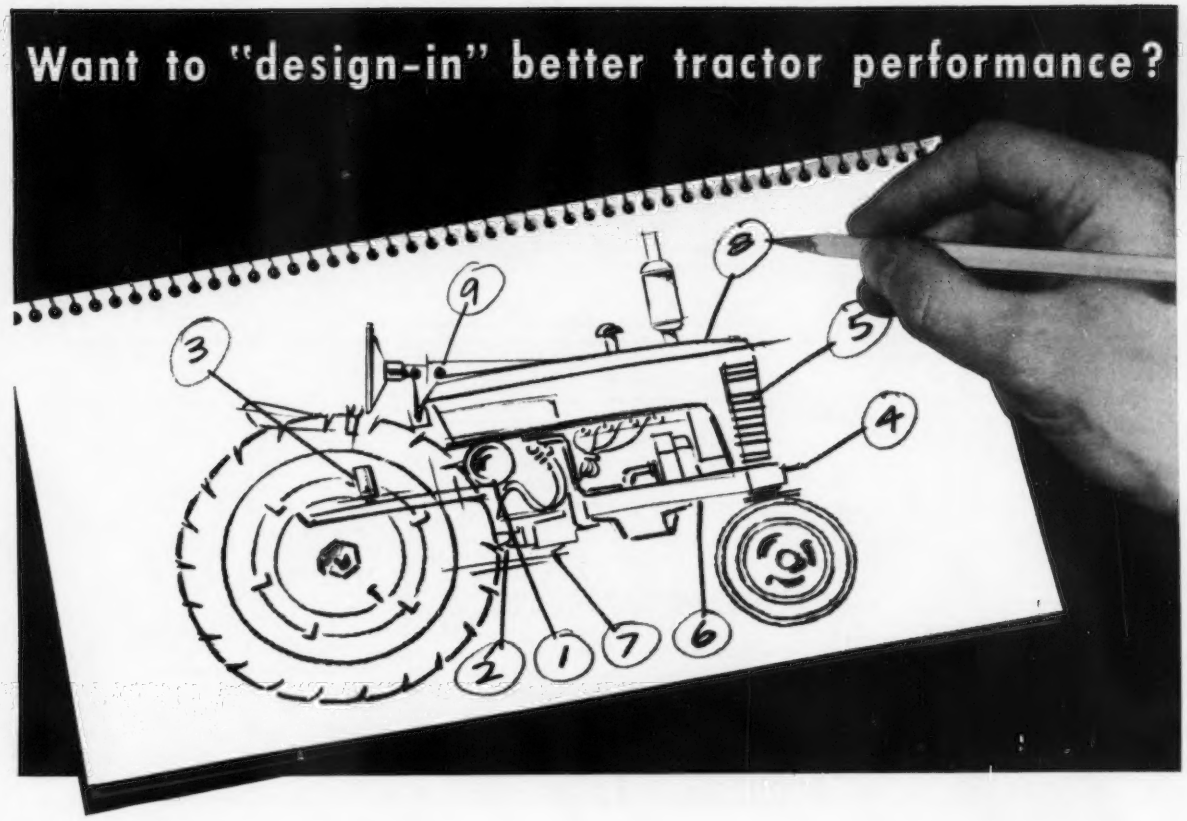
Georgia Section

The Georgia Section held its spring meeting on June 2 and 3 at the Wanderer Motel, Jekyll Island, Ga. The two-day meeting opened on Friday, June 2, with an afternoon registration, followed by a professional session. The evening was devoted to a technical program. The Saturday morning session opened with a technical program, followed by a business session. Saturday afternoon and early evening was a free time for recreation, while an evening entertainment concluded the meeting.

West Virginia Section

The West Virginia Section held a meeting on April 22 at West Virginia University. Following the luncheon at the Medical Center Cafeteria, the group toured new structures for the Colleges of Agriculture and Engineering. The ASAE movie, "Agricultural Engineering — The Profession with a Future" was viewed in the Agricultural Engineering Building, where a short business meeting was also held.

Members of the Ohio Section were guests of Willys Motors, Inc., for a plant tour during a Section meeting in Toledo, April 28 and 29. *(Above left)* Assembly of a "jeep" vehicle is observed as it moves along the assembly line by, left to right, J. E. Maust, Jr., W. E. Groeneveld, and T. Scott. *(Above right)* R. A. DeRegnaucourt, R. E. Crown, B. J. Lamp, ASAE President L. W. Hurlbut, and P. H. Rofkar, left to right, watch engines near final assemby. *(Right)* A total of 48 made the trip from the Secor Hotel to the Willys plant by chartered bus



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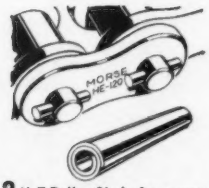
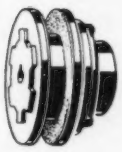
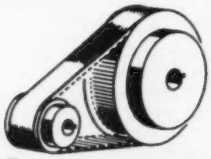


2 H-E Roller Chain for power transmission

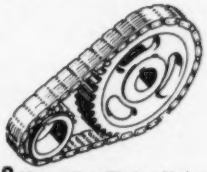


3 Morse torque limiter on power-take-off shaft

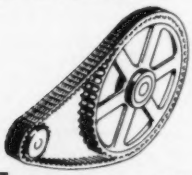
4 Morflex coupling on front-end drive shaft take-off



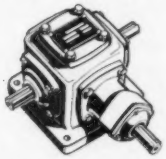
5 Timing® Belt drives for fuel injection application



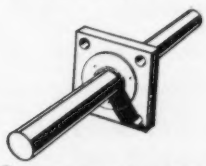
6 Morse silent Timing Chains for tractor engines



7 Hy-Vo® Drives for drop-box transmission



8 Miter boxes for pto drives for saws or grinding wheels



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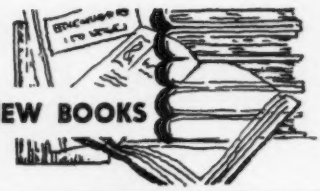

During the past few months there has been a large increase in the number of new books received for review. In order that all of these may be included in this column it has become necessary to list them only by title, author, publisher, size, and price.

The following eight books have been published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.:

Electronic Designers' Handbook, by Robert W. Landee, Donovan C. Davis, and Albert P. Albrecht. 6 x 9 in. 1016 pages. Illustrated. Price, $16.50.

Engineered Castings, by Glenn J. Cook. 6 x 9 in. 257 pages. Illustrated. Price, $8.50.

Principles of Control Systems Engineering, by Vincent Del Toro and Sidney R. Parker. 669 pages.

Applied Engineering Mechanics, Second Edition, by Alfred Jensen, assisted by Harry H. Chenoweth. 6 x 9 in. 409 pages. Illustrated. Price $6.50.

Mathematical Handbook for Scientists and Engineers, by Granino A. Korn and Theresa M. Korn. 6 x 9 in. 943 pages. Illustrated. Price, $15.00.

Engineering Fundamentals for Professional Engineers' Examinations, by Lloyd M. Polentz. 5⅜ x 8 in. 360 pages. Illustrated and indexed. Price, $9.50.

Science and Technology Encyclopedia. 15 volumes.

Graduate Education in the United States, by Bernard Berelson.

The following five books have been published by the Indian Council of Agricultural Research, Ministry of Food and Agriculture, Government of India, New Delhi, India:

Farmers of India, Vol. 1, by M. S. Randhawa and Prem Nath. 6½ x 9½ in. 302 pages. Illustrated. Price, $4.00.

Rice in India (Revised Edition), by R. L. M. Ghose, M. B. Ghatge and V. Subramanyam. 7¼ x 9½ in. 482 pages. Price, $4.00.

Beautiful Climbers of India, B. P. Pal. 5¼ x 9½ in. 109 pages. Illustrated. Price, $2.25.

Dry Farming in India, Second Edition, by Kanitkar, Sirur, and Gokhale. 6¼ x 9½ in. 486 pages. Illustrated. Price, $6.00.

Cotton in India—A Monograph, Vol. III, by B. L. Seth et al. 7½ x 11 in. 330 pages. Price, $6.50.

The following three books have been published by Prentice-Hall, Inc., Englewood Cliffs, N. J.:

Computer Logic, by Ivan Flores. 458 pages. Price $12.00.

Farm Building Design, by Loren W. Neubauer and Harry B. Walker. Cloth. 6 x 9 in. xii+611 pages. Illustrated and indexed. Price, $9.00 for text edition for classroom adoption, and $12.00 for trade edition.

Measurements for Engineering and Other Surveys, by Michael V. Smirnoff. Cloth. 6 x 9½ in. xii+556 pages. Illustrated and indexed. Price, $9.75.

The following four books have been published by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y.:

Household Equipment — Fifth Edition, by Louise Jenison Peet and Lenore Sater Thye. Cloth. 6 x 9¼ in. xiii+357 pages. Illustrated and indexed. Price, $9.25.

Mechanization of Motion, by Lee Harrisberger. Cloth. 6 x 9½ in. x+363 pages. Illustrated and indexed.

Nutritional Evaluation of Food Processing, edited by Robert S. Harris and the late Harry von Loesecke. 612 pages. Price, $12.00.

Principles of Plant Breeding, by R. W. Allard. Cloth. 6 x 9½ in. xi+485 pages. Illustrated and indexed. Price, $9.00.

The following two books have been published by The Ronald Press Co., 15 E. 26th St., New York 10, N. Y.:

Elements of Photogrammetry, by Wilfred H. Baker. 6 x 9½ in. Cloth. v+199 pages. Illustrated and indexed. Price, $5.00.

Forest Management — Second Edition, by H. Arthur Meyer, Arthur B. Recknagel, Donald D. Stevenson, and Ronald A. Bartoo. Cloth. 6 x 9½ in. v+282 pages. Illustrated and indexed.

The following two books have been published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.:

Index to ASTM Sandards as of December 1960. Paper. 6 x 9 in. ix+222 pages. Price, $1.00.

1960 Supplements to Book of ASTM Standards. Parts 1 through 10, covering 3,020 pages. Paper. 6 x 9 in. Price, $4.00 per part and $40.00 per set.

Conversion Factors and Tables, Third Edition, O. T. Zimmerman and Irvin Lavine. Cloth. 4¼ x 6 in. 710 pages. Published by Industrial Research Service Inc., Dover, N. H. Price, $7.50 ($8.25 outside USA).

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The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

Electric Heating Cable for Swine, by A. J. Muehling and D. R. Daum. Circular 830. Extension Service in Agriculture and Home Economics, College of Agriculture, University of Illinois, Urbana.

The two following publications are available from the Ontario Department of Agriculture, Parliament Buildings, Toronto, Ontario, Canada:

Laying Tile by Hand, by R. W. Irwin. Publication 36. March 1961.

Survey of Pump Drainage Installations in Ontario — 1957, by R. W. Irwin. Eng. Tech. Publication No. 3. 1960.

Proceedings of the Ninth Annual National Dairy Engineering Conference, February 28 to March 1, 1961, Michigan State University. The Continuing Education Service, Michigan State University, East Lansing. Price, $2.00.

Agricultural Engineering News, Ideas and Information, Vol. 6, No. 1, April 1961. Department of Agricultural Engineering, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

Ottawa Micro Flour Mill, by J. G. Kemp, A. G. O. Whiteside, D. C. MacDonald, and H. Miller. Reprinted from Cereal Chemistry, American Association of Cereal Chemists, Vol. 38, No. 1, January 1961. William Kalbfleisch, chief, engineering research service, Canada Department of Agriculture, Ottawa, Ontario, Canada.

The Manufacture of Instant Milk Powder, by Carl W. Hall and T. I. Hedrick. Reprinted from Dairy Engineering, January 1961. Carl W. Hall, agricultural engineering department, Michigan State University, East Lansing.

The following three bulletins are available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Perforated Vitrified Clay Pipe (Standard and Extra Strength). Commercial Standard CS143-60. Price, 5 cents.

Vitrified Clay Sewer Pipe (Standard and Extra Strength). Commercial Standard CS224-60. Price, 10 cents.

Safe Use and Storage of Flammable Liquids and Gases on the Farm, by Merrill S. Timmins, Jr. Farmers' Bulletin No. 2156. February 1961. Price, 10 cents.

The two following bulletins are available from Extension Division, University of Idaho, Moscow, Idaho:

Strength and Deflection of Bunker-Type Silo Wall Supports Under Simulated Silage-Pressure Conditions, by J. E. Dixon and J. W. Martin. Research Bulletin No. 50. March 1961.

Farm Water System, by D. W. Works. Farm Electrification Leaflet No. 52.

The four following bulletins are available from Agricultural Research Service, USDA, Beltsville, Md.:

Seed Losses in Harvesting Some Grass and Legume Crops in the Willamette Valley, Oregon, 1953-1954, by L. M. Klein, J. E. Harmond, and W. M. Hurst. Bulletin ARS 42-48. April 1961.

Long Fiber Burnishing, Ribboning, and Cleaning Machine, by Mills H. Byrom and Hiram D. Whittemore. Bulletin ARS 42-49. March 1961.

Vibrator Seed Separator, by J. E. Harmond and L. M. Klein. Bulletin ARS 42-50. March 1961.

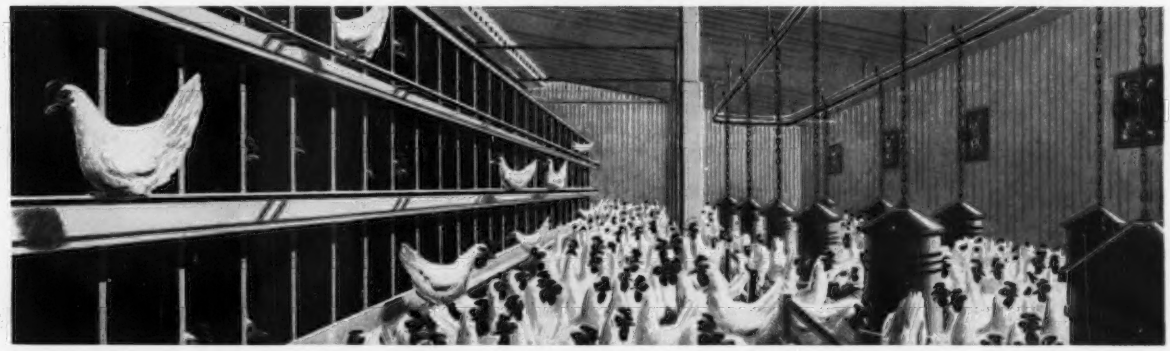
Mechanical Vibratory Feeder for Small Seeds, by Jesse E. Harmond. Bulletin ARS 42-51. March 1961.

Water Resources. The following five publications are available from Water Resources Association of the Delaware River Basin, 948 Suburban Station Bldg., Philadelphia 3, Pa.:

(1) *Special Bulletin: The Interstate-Federal Compact;* (2) *The Interstate-Federal Compact (complete text);* (3) *Too Much or Too Little: The Critical Water Problem of the Delaware River Basin;* (4) *Water for Your Ever-Expanding Needs;* and (5) *A Brief Report on the Syracuse Study.*

Climatic Tables for the World, by J. Papadakis. J. Papadakis, Cordoba 4564, Buenos Aires, South America.

1961 Year Book of the Tire and Rim Association Inc. The Tire and Rim Association Inc., 2001 First National Tower, Akron 8, Ohio. Price, $3.50.



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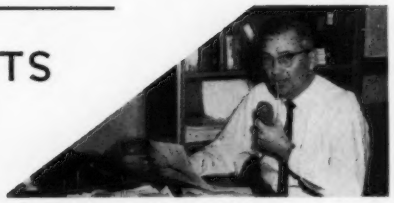
CHECK POINTS

by J. L. BUTT



Quo Vadis?

"Whither goest thou?" Progressive individuals, organizations, even nations must ponder this question periodically. ASAE is no exception.

For several years, the ASAE Council (Board of Directors) has felt the need for redefining the Society's long-range objectives. Two years ago, it decided to reach out and call upon additional members to weigh this question and our new Forward Planning Committee came into being. Your headquarters staff has deliberated the question carefully from the standpoint of its operations and has developed a document for study by the Finance Committee, the Forward Planning Committee, and the Council. It is entitled "A Program for Progress."

The basic objective in all these efforts is to visualize the role that ASAE will be called upon to fill five-, ten-, twenty-years hence. Such a study calls for self-examination, careful review of the past, extrapolations into the future, clarifications of policy and basic purpose, and generous amounts of courage, confidence, and leadership.

Some of the fundamental principles affecting the future of ASAE which have been generally accepted as basic to long-range planning are listed below:

1. Engineering will become increasingly important to agriculture in the future.

2. ASAE – the common meeting ground for engineers in industry, research, application, sales, promotion, and education – is uniquely qualified to give direction and motivation to agricultural engineering progress.

3. Through its publications, committees, divisions, sections, and professional contacts ASAE already has an established mechanism for professional progress.

So the basic ingredients for progress already exist – potential, interested personnel and organizational machinery. The question then boils down to "what steps should ASAE take to fulfill its role of providing maximum service and leadership for the agricultural engineering profession?" The question also seems to have two major elements: (I) those things we need to begin doing something about immediately, and (II) those we should begin thinking about for action in the near future.

I. Many important steps require immediate attention: more publication space for technical articles; better public relations; expanded national and international contacts; more publicity; more individual services for members; more career promotional efforts; more committee activity; more standards, recommendations, and data; more services to sections and divisions; more professional activity; more encouragement of students; and so on.

But let us review the record of the past several years with the above objectives in mind. In practically every area significant progress has been made. There are the Transactions, the numbered technical paper series, the newly authorized monograph series, and several special publications to help provide more publication space. Committee work and activity has expanded rapidly (example: 70-odd committee meetings during winter meeting). A growing public relations program is a reality. The profession is receiving considerable publicity as a result of press room activities at its meetings and periodic releases from Society headquarters. The major requests for services to sections are being met. Individual member services (Personnel Service, requests for information, publications, papers, contacts) are usually filled. Standardization and data development activities have expanded. Contacts with other professional and trade groups, national and international, enjoy favorable and expanding status.

We believe this represents commendable progress by the members and committees of ASAE. But we are also confident that our membership is almost unanimous in its desire to extend, in fact accelerate, progress in all these fields. This is certainly the desire of the Council and the headquarters staff. But this is also the area in which we are experiencing "growing pains."

For example, each new contact with other professional organizations means that ASAE must supply an interested member or members to represent its viewpoint in the committee work and other activities of the new cooperating organization. Each new promotional activity, such as the Five-Step Plan, requires dedicated agricultural engineers willing to supply the manpower to translate the program into action. Each new standard, recommendation, or compilation of data, each Society meeting, and each public relations venture or publications effort requires the efforts of dedicated members and committee workers. And intricately interwoven among all such activities is the Jason's quest of finding the funds to finance those things which obviously should be done.

So the solution to the immediate problems confronting our professional organization seems to point to further expansion of present programs and activities, to continued dedicated work by members, and to developing the funds needed to support an expanding program. Your Council, Finance Committee, and division officers are *already* devoting major emphasis to this part of the question – as the record will show.

II. What about the longer-range development of ASAE to serve our profession? Here, the best thinking of all our members is needed. Each member is urged to communicate his thoughts, through our divisions and sections, to those officers who must translate into policies and actions the direction of our development as a professional organization. Some reflections and projections may be helpful.

1. If ASAE continues to develop during the next decade *only* at the same rate of growth as during the past ten years, it will
   - *(a)* Add two new types of publications
   - *(b)* More than double its membership
   - *(c)* Have 45 or more sections
   - *(d)* Have twice as many papers submitted for publication
   - *(e)* See national meeting attendance al-almost double
   - *(f)* Have half again as many working committees
   - *(g)* See its national and international contacts and responsibilities multiply.

What steps should be taken to anticipate this growth and give it necessary guidance and encouragement?

2. New opportunities for engineering service to agriculture are emerging constantly – the engineered farmstead, consulting services, engineering sales services, farm management engineers, the engineering services associated with the food and feed industries, and continued expansion and refinements in usual areas of work. Is our organizational structure (which is about 40 years old) still entirely adequate to serve and support all the areas of agricultural engineering technology?

3. Agricultural engineering enrollment has not kept pace with growing opportunities for service. Do our publicity programs, our public relations, our career services, national and local, accurately and thoroughly present the story of agricultural engineering?

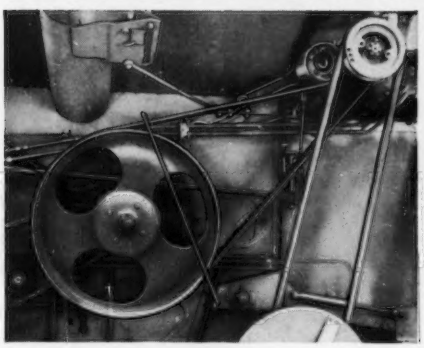
4. Forty-seven agricultural engineering curriculums have been recognized by ASAE, and almost three-fourths of all AE curriculums in the U. S. are ECPD accredited. Professional registration is being actively encouraged and promoted by most ASAE sections. Do our curriculums give optimum preparation to today's student who will be at the peak of his career in 1990? What problems will he be called upon to solve?

5. ASAE members play prominent roles in the agriculture of around 70 countries of the world. ASAE is represented at many international congresses, has given assistance to those persons organizing agricultural engineering societies in several other nations. Should we continue to expand our international efforts and are we equipped to do so?

6. In recent years ASAE has actively affiliated or cooperated with many national organizations (EJC, ASEE, AAAS, NAS-NRC, NCSBEE, NSPE, ECPD, NFPA, etc.). Should we continue to seek closer cooperation with these and other groups? (Remember, it requires willing workers and supporting funds.)

7. Limitations in the methods and rates of dissemination of the growing volume of data, research reports, and information show promise of becoming a restraining influence on technological progress. Are there new techniques which could be employed to advance the information-flow processes?

This brief review will perhaps point up some of the decisions that must be made by leaders of our profession in the near future. Undoubtedly still others will occur to you. But the important point we wish to make is that plans must be made, our course must be charted, and we must see that our vehicle for professional progress (ASAE) is prepared for the journey ahead.



Close-up of Deere unit shows Condor Flat Whipcord Belt on a separator drive and two Manhattan Agricultural Traction Drive V-Belts transmitting power from engine to wheels through a variable speed sheave.

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Unconventional Makes Good

AN unconventional construction procedure resulted in a low-cost, high-strength grain elevator "rather conventional" in appearance and performance. Willis C. Fry, an enterprising individual, in Harrisburg, Ore., built his own grain elevator five years ago in which the exterior walls and interior bin walls are constructed exclusively of 2 x 4's in the lower grades of Douglas fir.

In construction a concrete foundation is laid, and the bottom layer of 2 x 4's is secured. Starting from one corner, the layout of the walls is made square and level. As additional layers are applied, a 2 x 4 is nailed vertically on each corner, and checked with a plumb line (Fig. 2). This board serves as a guide for the layers, and is realigned and raised as many times as is necessary. The mortise and tenon principle is used in corners where interior bin walls meet exterior walls with alternating layers overlapping each other on corners. The wall boards are laminated with 16d box nails.

Fig. 2 View looking downward shows a vertical 2 x 4 which serves as guide to align walls

The complete structure, after the addition of a fourth section since the original portion was completed, will be 50 ft wide and 116 ft long. The laminated walls will be 38 ft high requiring 200,000 board feet of lumber. A corrugated metal roof will cover the distribution system. It will contain 66 storage bins (minimum size 8 ft by 8 ft and maximum size 20 ft by 35 ft) and reportedly will store 4,500,000 lb of rye grass seed.

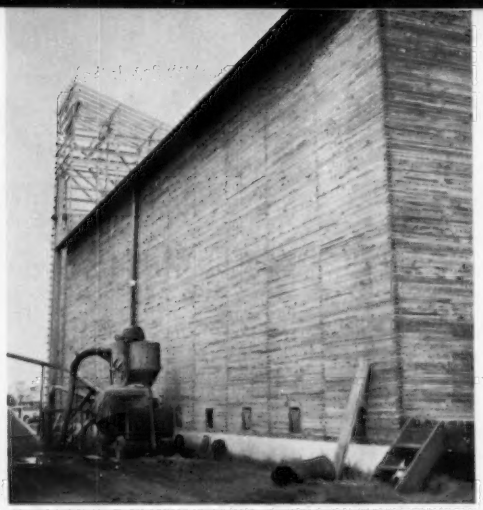


Fig. 1 Original structure, five years old, has withstood test of wind and rain

Fig. 3 Wall boards (2 x 4's) are laminated with 16d box nails

MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Vapor Seal Literature

W. R. Meadows, Inc., Elgin, Ill.— Booklet No. 16 and Catalog No. 1660 tell how to eliminate moisture problems with vapor seal; also a 32-page brochure ($1.00) entitled "Design Techniques for Controlling Moisture and Condensation in Building Structures," describes and illustrates moisture movement, condensation, effect of wall insulation on condensation, water vapor permeability of various building materials, effect of moisture on the thermal conductivity of various materials, crawl spaces, slab-on-grade construction, core walls, roof decks, and suggested specifications.

Vinyl Pond Linings and Silo Coverings

Agricultural Plastics Co., 3935 Seyburn, Detroit 14, Mich.— A folder entitled "Preserve the Quality of Quality Silage" describes and illustrates vinyl silo covers and caps; and a reprint entitled "Vinyl Film Liner for Earth-Fill Reservoirs" describes vinyl pond linings.

Electronic Cotton Classer

United States Testing Co., Inc., 1415 Park Ave., Hoboken, N. J.— A 6-page brochure describes and illustrates the "scanor-tron," an electronic instrument for scientific evaluation of cotton grade. Five different qualities (or parameters) of cotton are measured, namely: Color (or yellowness); brightness (or reflectance); character (or preparation); leaf area (or trash); and leaf count (or size of trash particles).

Aerial Spray Equipment

Agricultural Aviation Engineering Co., 858 Scott St., Santa Clara, Calif.— An 8-page catalog, No. 161-1, describes and illustrates individual components and systems for airplanes and helicopters, including: spray pumps; pump mounts; strainers; power take-offs; spray valves; fiberglass tanks; plumbing accessories; and spray kits. A 3-page price list is also included.

Geared Flexible Motor Couplings

Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.— A 6-page folder (No. 2975) brings together the pertinent data on the type MC geared flexible motor couplings, including three new features — corrosive duty cover, a spacer adapter, and the addition of a larger size (application range of couplings now extends to a 2⅞-in. bore size).

Offset Side Bar Chain and Flat-Top Roller Chain

Acme Chain Corp., 821 Main St., Holyoke, Mass.— A 4-page, 2-color bulletin, No. 8, describes and illustrates the offset side bar chain used for rugged installations such as oil field, construction machinery, transit mixer, and other usages. Bulletin No. 9, a 4-page, 2-color piece, describes and illustrates the precision-made flat-top conveyor roller chain. Prices and sizes are also included.

Remote Indicating Load Cell System

W. C. Dillon & Co., Inc., 14620 Keswick St., Van Nuys, Calif.— A 12-page engineering manual (Bulletin R-2) illustrates uses of remote indicating load cell systems throughout industry, suggests ideas for applications not commonly known, and compares the differential transformer principle with conventional tube and circuitry designs. Compression, tensile, and push-pull models are covered, as well as 33 capacities from 0-100 lbs through 0-1,000,000 lbs. Also included is scientific data for in-plant engineering of complete projects.

4-Wheel Drive Loaders

J. I. Case Co., Racine, Wis.— A 16-page, color bulletin describes and illustrates the three models of 4-wheel drive loaders. Specifications are also listed.

Power Sprayers and Cotton Picker

Allis-Chalmers Manufacturing Co., Farm Equipment Division, Milwaukee 1, Wis.— Bulletin TL-2369, a 16-page, 2-color booklet, describes and illustrates line of power sprayers including the precision, boom, or broadcast type. Bulletin TL-2389, a 4-page, 2-color brochure, describes and illustrates Model 616 two-row cotton picker, including specifications.

Pressure Switches

Pall Corporation, 30 Sea Cliff Ave., Glen Cove, N. Y.— Bulletin E8, a 2-page, 2-color circular, includes photographs and drawings of the adjustable pressure and differential pressure switches together with a description of their construction and operation, optional variations and available accessories. Also included is data on applications, porting, and the fluids with which the switches may be used.

Fertilizer Bucket

Webster Manufacturing, Inc., Tiffin, Ohio —Bulletin K-496, a 3-color folder, describes and illustrates a malleable iron bucket for handling of fertilizer and similar materials. Included are drawings of the new features of the bucket.

Wheel Packages

French & Hecht Division, Kelsey-Hayes Co., P.O. Box 690, Davenport, Iowa — Bulletin 613 describes wheel packages that carry loads from 500 to 3000 lbs and includes the listing of the following groups: The 500-lb hub and spindle assembly for use with 4-bolt wheels; the 2000-lb hub and spindle group to accommodate 5-bolt wheels and the 2000-lb group to use 6-bolt wheels.

Accessories for Fluid Power Systems

Aeroquip Corporation, Jackson, Mich.— Farm Catalog No. 634, a 16-page publication, covers in detail, including illustrations: flexible hose lines with detachable, reusable fittings; push-pull self-sealing, and breakaway couplings, and other important related accessories for farm equipment fluid power systems.

Chemical Safety Data

Manufacturing Chemists' Association Inc., 1825 Connecticut Ave., N.W., Washington 9, D.C.— Revised editions of four chemical safety data sheets on benzene, SD-2; nitric acid, SD-5; paraformaldehyde, SD-6; and anhydrous ammonia, SD-8 list the characteristics, hazards, engineering control of hazards, employee safety procedures, fire fighting techniques necessary, recommended handling and storage practices, tank and equipment cleaning and repair procedures, waste disposal, medical measures necessary, and first aid requirements.

Film Extrusion Polyethylene

Monsanto Chemical Co., Plastics Division, Department TF, Springfield 2, Mass. — Data sheet describes and illustrates with graphs polyethylene film resin 706X. Included are typical film properties and typical resin properties under the headings: property; test method; units; specifications; and typical values.

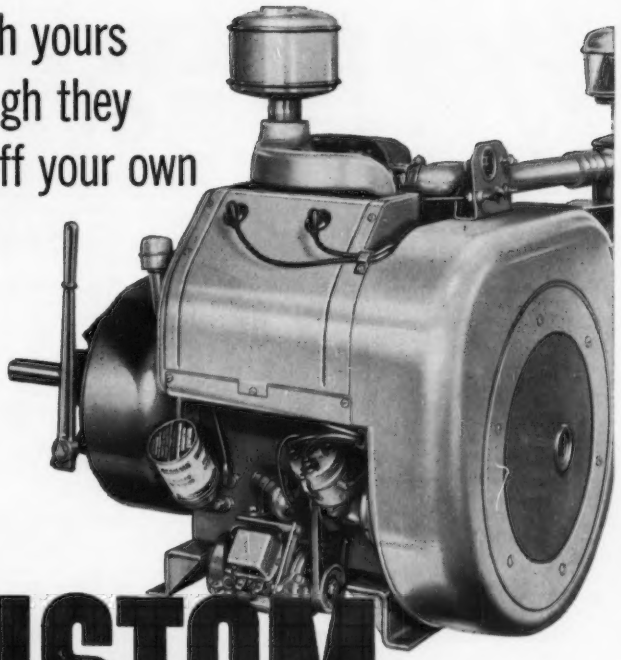
Hay and Forage Equipment

Lundell Mfg. Co., Inc., Cherokee, Iowa— A literature kit on farm implement equipment line includes pieces on feed wafering machine, hay conditioner, forage harvester, and others.

LP-Gas Carburetion

Marvel-Schebler Products Division, Borg-Warner Corp., Century Gas Equipment, Decatur, Ill.— A 6-page, 2-color brochure, entitled "How Farm Fleet Industrial Motor Fuel Users Save More Money," covers LP-gas carburetion and its uses. The following topics are included: A description of LP-gas as a motor fuel; an illustrated description of the features of complete line of LP-gas carburetion systems; LP-gas carburetion as applied to the farm and trucking industry; and as applied to industrial truck uses.

as much yours as though they came off your own board



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DIRECT DRIVE — special crankshaft extensions are available threaded, tapered, splined, special diameters and lengths, various keys, etc., for close-coupled pumps, generators, and other equipment.

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OTHER ACCESSORIES — automotive and spark-arresting mufflers, pre-cleaners, drive pulleys for flywheel, and rewind starters for ACN and BKN engines.

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For best results, consult our engine specialists during the preliminary and design stage of your product development. In the meantime, send for Bulletin S-249 and familiarize yourself with the entire Wisconsin line of air-cooled engines — 3 to 56 hp. Write Dept. O-40.

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The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Allen, Kenneth L. — Product dev. engr., East Moline Wks., International Harvester Co. (Mail) 3006 38th Ave., Rock Island, Ill.

Ayyildiz, Mustafa—Asst. dir., faculty of agr., agr. eng. dept., Ankara Univ. (Mail) Irrigation Dept., University of California, Davis, Calif.

Batterson, Bruce E.—Salesman, Marlin Rockwell Corp. (Mail) R.R. 4, W. Locust St. Ext., Davenport, Iowa

Berry, Henry W. — Sr. dev. engr., Mississippi Power & Light Co., P.O. Box 1640, Jackson, Miss.

Borhan, Amir — Supervisor of training section, agr. eng. dept., Ministry of Agriculture, Mohandesi Zerai, Saadi Ave., Tehran, Iran

Bramsen, Svend — Vice-pres. and treasurer, Spraying Systems Co., 3201 Randolph St., Bellwood, Ill.

Browder, Robert H. — Agr. engr., area dev. div., Texas Electric Service Co., P.O. Box 970, Fort Worth, Texas

Dawson, Robert H. — Fruit handling spec., div. of tropical res., Tela Railroad Co., La Lima, Honduras

Dibble, Edward F. — Consulting engr., 8 W. Citrus Ave., Redlands, Calif.

Downing, Donald G. — Jr. designer, John Deere Harvester Wks. (Mail) 1832 13th Ave., Moline, Ill.

Duncan, Patrick F. — Supervisor, product knowledge and sales dept., International Harvester Co., P.O. Box 4838, Atlanta 2, Ga.

Febre, Roberto E. — Product engr., International Harvester Co. of Mexico, Apartado 131, Saltillo, Coah, Mexico

Henderson, Donald E. — Rural engr., Georgia Power Co., P.O. Box 4545, Atlanta 1, Ga.

Hubbard, Albert B. — Product engr., Minneapolis-Moline Farm Equip. Div., Motec Industries, Inc. (Mail) P.O. Box 36, Victoria, Minn.

Johnson, Edward J. — R.R. 1, Box 173, Wallace, N. C.

Killey, Ralph W. — Product res. and dev. dept., Container Corporation of America, 900 N. Ogden Ave., Chicago, Ill.

Lagier, Thomas F.—Work unit engr., (SCS) USDA, Box 860, Lovelock, Nev.

Martin, J. W. — Consultant, R. M. Smith & Associates. (Mail) R.R. 2, Box 266, Grenada, Miss.

Milbradt, Thomas A. — Agr. engr. and asst. area engr., (SCS) USDA. (Mail) 120 Knollcrest Drive, Apt. 202, Mankato, Minn.

Pierce, Bernard T. — Agr. engr., (SCS) USDA. (Mail) 713 Spruce St., Leavenworth, Kans.

Quackenbush, Harold E. — Test engr., Farm Equip. Res. Eng. Center, International Harvester Co. (Mail) 6111 Pershing Ave., Downers Grove, Ill.

Ravina, Israela — Res. asst., dept. of agr. eng., Israel Institute of Technology. (Mail) 80 Berl St., Nave Shaanan, Haifa, Israel

Richardson, Harvey H. — Civil engr., (SCS) USDA. (Mail) 1795 E. Dunedin Rd., Columbus 24, Ohio

Sedam, Cornelous A. — Draftsman, John Deere Plow Wks., 1225 Third Ave., Moline, Ill.

Simpson, Willy G. — Adviser in irrigation, Caja De Credito Agrario, Industrial Y Minero, Bogota, Colombia, So. America

Spooner, Joe L. — Agr. engr., (SCS) USDA. (Mail) P.O. Box 113, Cumming, Ga.

Stivers, O. O. — Mgr., member serv. dept., Choptank Electric Co-op., Inc., Denton, Md.

Vidrine, Clyde — Des. engr. II, cultivator group, Farm Equip. Res. and Eng. Center, International Harvester Co. (Mail) #7 Elm 9800 W. Joliet Rd., LaGrange, Ill.

White, Samuel W., Jr. — Pres., Oliver Corp., 400 W. Madison St., Chicago 6, Ill.

Ziskal, Joseph F. — Mgr. of eng., International Harvester Co., Ltd. of Great Britain, Wheatley Hall Rd., Doncaster, England

TRANSFER OF MEMBERSHIP

Baker, H. Harlan — Agr. engr. and electrical power use advisor, Public Service Co., 33 N. Williams St., Crystal Lake, Ill. (Associate Member to Member)

Cook, Henry C. — Washita Basin Proj., Bur. of Reclamation, USDI. (Mail) 2001 Custer Ave., Clinton, Okla. (Associate Member to Member)

Gillette, Roy A. — Product des. engr., and head, harvesting div., J. I. Case Co. (Mail) 3523 Avondale Dr., Rockford, Ill. (Associate Member to Member)

PERSONNEL SERVICE BULLETIN

Note: In this bulletin the following listings current and previously reported are not repeated in detail. For further information, see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this bulletin, request form for Personnel Service listing.

Positions Open—(1960) **December**—O-407-649. (1961) **January**—O-434-654, 440-655, 461-656, 465-657, 465-658. **February**—O-11-101, 13-102, 10-103, 35-104. **March**—O-67-107, 76-108, 77-109, 71-112, 71-113. **April**—O-129-115, 129-116, 95-117, 155-118, 163-119. **May**—O-189-120, 198-121, 199-122, 212-123, 218-124, 226-125.

Positions Wanted—(1960) **(December)**—W-420-89, 419-90. (1961) **January**—W-444-95, 453-96. **February**—W-8-1, 21-2, 22-3, 29-5, 16-6, 30-7, 34-8. **March**—W-58-11, 56-12, 75-14. **April**—W-121-16, 112-17, 135-18, 142-19, 115-20, 160-21, 161-22, ,162-23, 164-24, 166-26, 171-27, 178-28. **May**—W-187-29, 190-30, 97-31, 200-32, 201-33, 202-34, 203-35, 204-36.

NEW POSITIONS OPEN

Agricultural Engineer (assistant instructor) to assist in teaching farm power and machinery and agricultural processing while working toward an MS degree. Some research on forage handling and preservation. Eastern state university and agricultural experiment station. BSAE or equivalent, with grade average of 2.5 on the basis of top grade being 1.0. Sincere interest in research and desire to earn MS degree. Small, cooperative department staff. Salary $4524, with one month vacation. O-257-126

Agricultural Engineers (2 research fellows) to work on research projects and MSAE degree, in an eastern state university. One project on environmental conditions for poultry. One assignment with choice from several optional harvesting and forage problems. BSAE or equivalent, with grades satisfactory to graduate school. Sincere interest in research. Desire to earn MS degree. Small, cooperative department staff. Salary $1800, including tuition, tax free. Free housing for single students in cottage in agricultural engineering department area. O-257-127

Agricultural Engineer (Assistant Professor) for teaching and operations research activities related to practical agricultural problems, in a Canadian university. Industrial engineering degree, or equivalent. Graduate degree preferred. Farm background. Must have training in operations research techniques and be familiar with modern computational methods. Excellent prospects for advancement. Salary $7,500. Opening effective Sept. 1. O-265-128

Agricultural Engineer to head agricultural machinery maintenance department for large processor in Midwest. Will be responsible for organizing, directing and supervising work of the department. Will also work with general engineering department on new projects and developments. Age 22-30. BSAE. No experience required. Farm background preferred. Must understand agricultural engineering problems and have supervisory ability. Opportunity for advancement based on ability. Salary $475 to $525 per month. O-259-129

ASSISTANT PROFESSOR

Assistant Professor, Department of Agricultural Engineering, University of Alberta. Starting salary of $7,500. Excellent prospects for advancement. Duties to commence September 1 and include undergraduate teaching, participation in operations research activities and their application to practical agricultural problems. Must have training in operations research techniques and be familiar with modern computational methods. Prefer advanced industrial engineering degree or equivalent, and farm background. Send details of qualifications, list of publications, personal information, a recent photograph, and three references, addressed to: Chairman, Department of Agricultural Engineering, University of Alberta, Edmonton, Alberta.

NEW POSITIONS WANTED

Agricultural Engineer for extension, teaching or research in power and machinery or product processing with college or experiment station. Any location. Some travel. Married. Age 40. Minor disability, service connected. BSAE, 1943, A & M College of Texas. MSAE, 1951, University of California. Farm background. War commissioned service in Army Corps of Engineers. Teaching and research experience in power and machinery 8 years, University of Arizona. Research project leader in farm mechanization, University of Idaho, 1¾ years. Research project leader on mechanizing cotton production and harvesting in the high plains area, USDA. Registered professional engineer. Available on two months' notice. Salary open. W-244-37

Agricultural Engineer, new graduate, for field testing, design, and development in power and machinery, with manufacturer or federal agency in West or Midwest. Married. No disability. BSAE, June, Montana State College. Work experience three summers studying hazard reduction with different sizes and makes of track-type tractors in logging terrain and operations. Active commissioned service in Army 2 years. Available June 15. Salary open. W-236-38

Agricultural Engineer for development, research, or sales in power and machinery or soil and water field with industry or public service, preferably in Southeast. Willing to travel. Present employer may be contacted. Single. Age 35. No disability. BSAE, 1948, Clemson. MSAE, 1950, VPI. Teaching, research, and equipment sales experience. War non-commissioned service in Infantry. Available on reasonable notice. Salary open. W-264-39

Agricultural Engineer for design, development, research or extension in Soil and Water field with industry or public service. Any location. Married. Age 25. No disability. BSAE, 1948, Pennsylvania State University. Certificate of Completion in Meteorology, 1959, St. Louis University. Farm background. Research in fluid flow part time 2 yr. and full time 2 months. Weather forecasting in USAF, 2 yr., commissioned service. Interested in opportunity to continue education. Available about Oct. 1. Salary open. W-247-40

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RESEARCH NOTES

Brief news notes and reports on research activities of special agricultural-engineering interest are invited for publication under this heading. These may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Michigan.

New Method of Checking Spraying Effectiveness

A new technique for measuring the distribution of pesticide sprays on crops has been developed by an agricultural engineer working at the ARS field station at Forest Grove, Ore. In the new testing procedure, small patches of adhesive-backed mylar film are stuck on leaves and other plant surfaces which are sprayed with a solution containing dye. The film is then removed and investigated under a microscope for the quantity and distribution of droplets. It was reported that a mylar rather than a cellulose base was used to avoid absorption of dye into the film.

New Leaflet on Standby Electric Power Equipment

"Standby Electric Power Equipment for the Farm," a new USDA leaflet (No. 480), describes the size, installation and operation of a standby generator for farm use. Copies are available from the farm electrification research branch of the ARS Agricultural Engineering Research Division, Beltsville, Maryland.

Analog Computer Speeds Data Reduction

Agricultural engineers at the USDA National Tillage Machinery Laboratory have found an interesting use for analog computers in data reduction. Signals from test instrumentation are fed into various multiplier and summing units of an analog computer, and resulting functions are plotted instantaneously against other variables while the test is performed. Thus, in a tillage test, power can be computed and plotted on X-Y recorders against such variables as speed and depth of cut. On model studies various pi-terms can be computed by appropriate wiring of the computers and plotted against one another, or against particular variables, on X-Y recorders.

This arrangement has three chief advantages: (*a*) There is a large saving of professional and subprofessional labor in reducing data from strip charts and computing various functions; (*b*) There is an increase in accuracy because of the elimination of data smoothing inherent in digitizing information from strip charts; and (*c*) Engineers can see the results of their experiments immediately. It also permits a repeat of the experiment when it is obvious that an error has been made, or a repeat in which a variable is changed while other conditions are maintained in order to get more useful data, even after several weeks or more have elapsed.

Southern Plan Exchange Fills Two Posts

W. T. Cox of Alabama was named chairman of the Southern Regional Committee of the Southern Plan Exchange and Max Faulkner of Tennessee was named chairman of Farmhouse Plans during a recent meeting of the exchange in Jackson, Miss. The next meeting will be in Birmingham, Ala., early in November 1961.

USDA Announces New Bulletins

Two new bulletins, "Soil Temperature—A Guide to Timely Cotton Planting" and "Vapor Pressure Determination of Seed Hygroscropicity," are now available.

The first bulletin, based on research by ARS engineers and an agronomist of the Texas Agricultural Experiment Substation at Lubbock, recommends delaying cotton planting until minimum soil temperature reaches a 60 F, 10-day average at an 8-in. depth.

The other bulletin, based on cooperative research between ARS and state agricultural engineers at the Georgia Experiment Station at Athens, is concerned with the vapor pressure exerted by moisture contained within seed at known moisture content and temperature.

Copies of either publication may be obtained from the respective experiment stations. Limited copies are also available at the ARS Harvesting and Farm Processing Research Branch, Plant Industry Station, Beltsville, Md.

Agricultural Engineers Attend Poultry Health Symposium

A research conference on disease, environmental and management factors related to poultry health was held March 20-22 in Jefferson Auditorium at the U.S. Department of Agriculture, Washington, D.C.

The conference, at which veterinary scientists, poultry husbandmen and agricultural engineers were speakers, was called to discuss ways to deal with the growing condemnation problem in the broiler industry. Since disease is the basis for most condemnations, the speakers all stressed the value of various management practices and environment improvements to control of poultry diseases.

All papers read at the conference will be assembled and distributed as proceedings. Copies may be obtained from Robert G. Yeck, Agricultural Engineering Research Division, Agricultural Research Service, USDA Plant Industry Station, Beltsville, Md.

New Seed Cleaning Handbook

A new handbook, "Seed Cleaning and Handling," has been published by USDA. Authors are Jesse E. Harmond, Leonard M. Klein, and N. Robert Brandenburg, all of ARS.

Copies of the new handbook may be obtained by writing to AERD, ARS, USDA Plant Industry Station, Beltsville, Md.

AERD Employees Recognized

Five employees of the Agricultural Engineering Research Division, ARS, USDA, recently received Certificates of Merit for outstanding performance. They are: D. M. Alberson, Southwestern Cotton Ginning Research Laboratory, Mesilla Park, N. Mex.; J. E. Harmond, Small Seed Harvesting and Processing Investigations, Corvallis, Ore.; A. T. Hendrix, Farm Structures Research, Athens, Ga.; W. V. Hukill, Grain Harvesting Conditioning Investigations, Ames, Iowa; and J. H. Levin, Fruit and Vegetable Harvesting Investigations, East Lansing, Mich.

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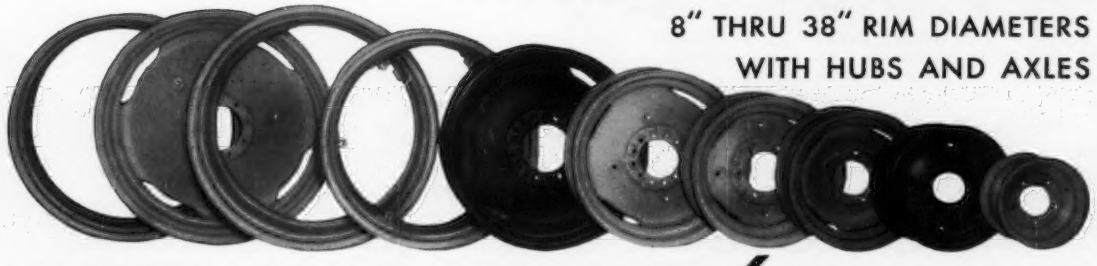

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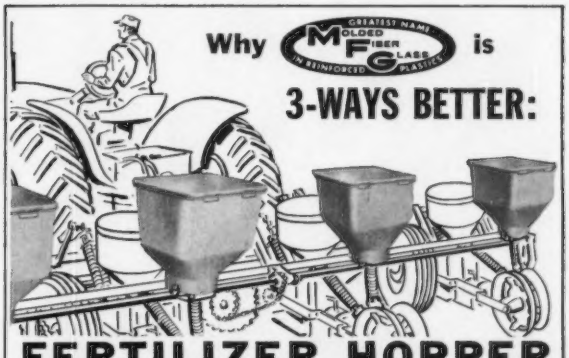

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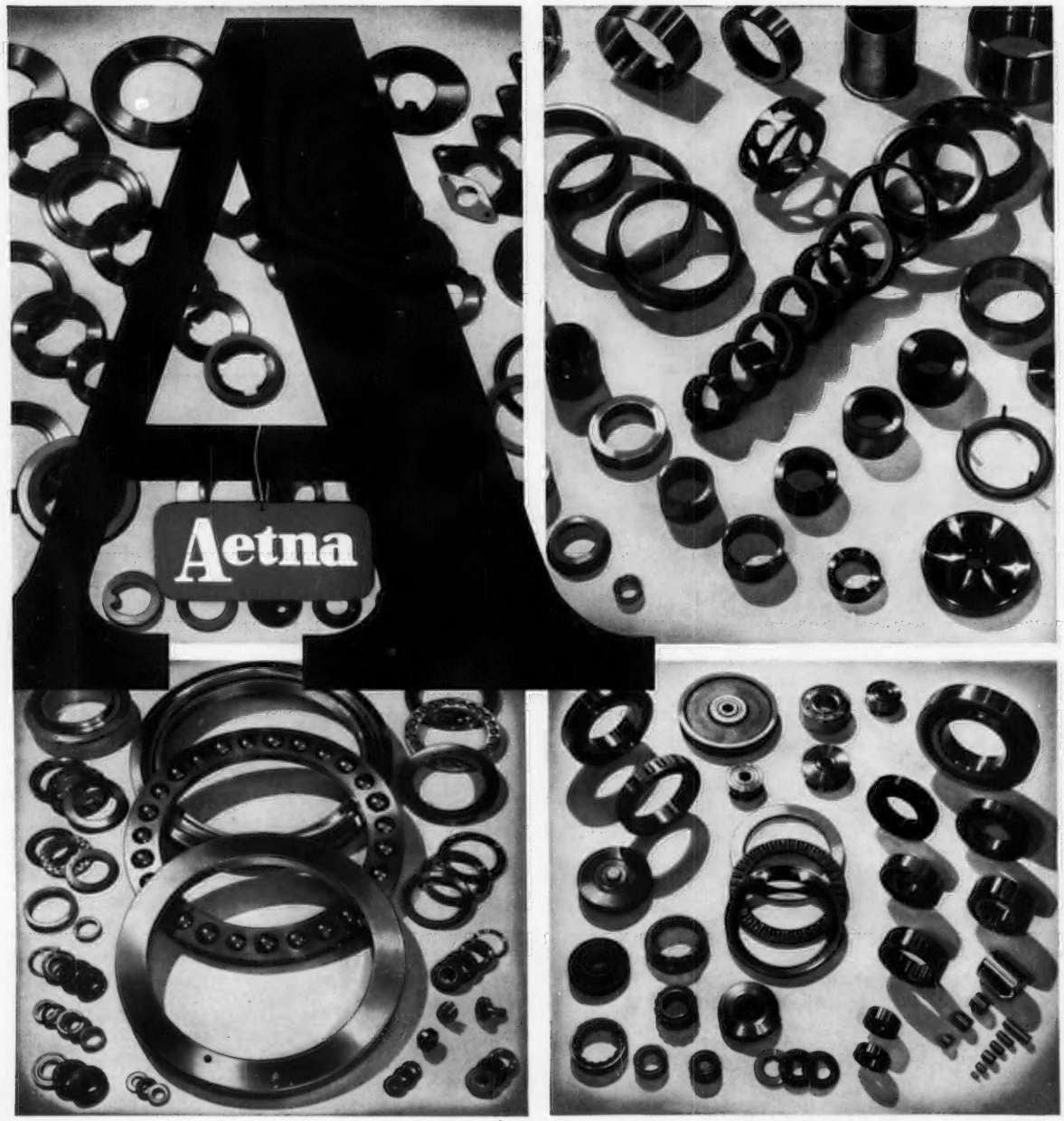

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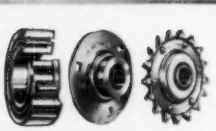

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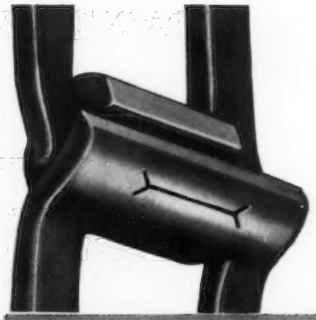

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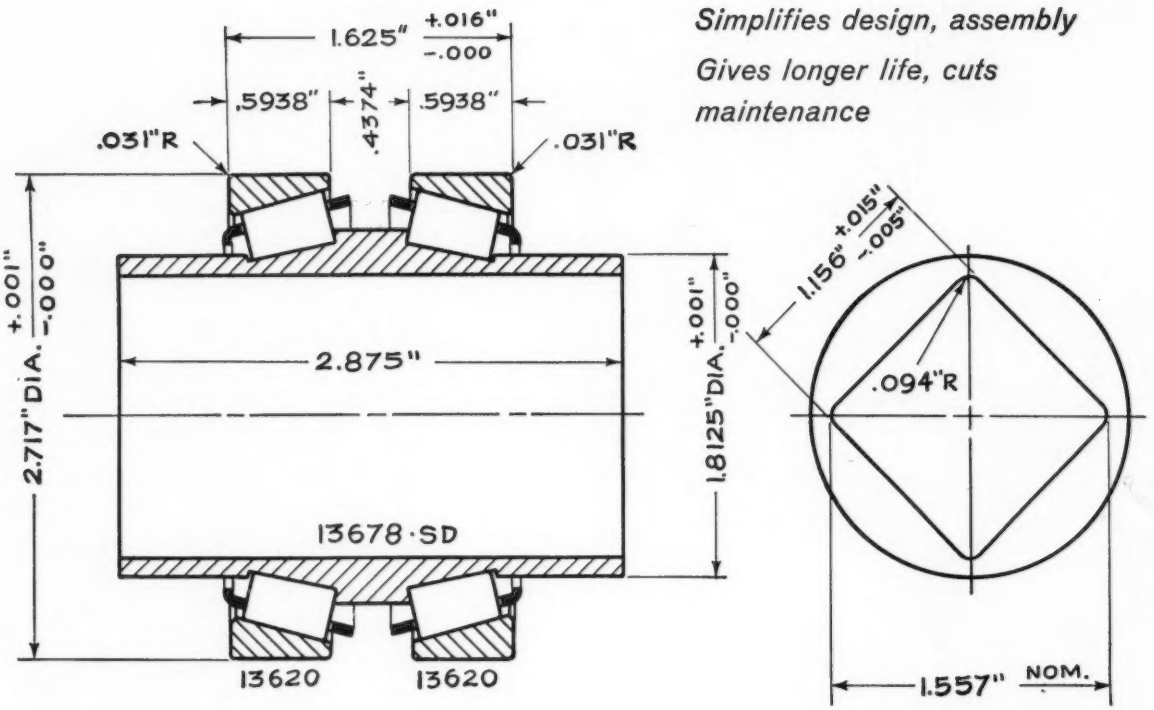

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